SUMMARY REPORT
CeNCOOS Climate and Coastal Resilience Meeting – Spring 2023
Bodega Marine Lab
24-25 May 2023

About
On May 24-25, 2023, the CeNCOOS Governing Council, Principal Investigators, and key community partners gathered to review plans and assess emerging priorities related to coastal and climate resilience for the region.

Key take-aways
- Climate and coastal resilience necessitates timely and locally relevant information. CeNCOOS can work to improve its connection to the people who use data, including connection with local communities and municipal governments.
- There are many sea level rise, inundation and flooding activities happening across the state (research and products). NOAA Office of Coastal Management (OCM) is leading the assembly and delivery of many water level products, e.g. the Coastal Inundation Dashboard. CeNCOOS can contribute to this existing suite of information products.
- Waves are important for water level and tidal predictions and often lack the granularity needed to inform local-scale predictions. This warranted discussion around low-cost wave buoys and webcams. Coupled wind, waves, tides, water levels, and webcams can give a complete picture. Where there are gaps, especially in the very nearshore, CeNCOOS can contribute.
- Some areas within the CeNCOOS region are well-studied while other communities, including some traditionally underserved and marginalized groups, are still without essential observational coverage,. CeNCOOS can look to filling gaps in local coastal ocean information to improve resiliency to the changing climate and local engagement can inform any new activities.
- Interest in developing a push-notifications and mobile system with user-defined thresholds continues to grow, but implementation and liability need ongoing discussion, including with IOOS with respect to RCOOS certification and liability protection.
- Collaborating with fisheries would be very valuable, particularly in the context of assessing offshore wind impacts and mitigation of expected changes in fisheries assessments.
- There is a need for a more coordinated process for monitoring offshore wind (OSW) impacts (e.g., impacts to upwelling processes, marine mammals/ seabirds, etc.)
- Passive monitoring will become more important with OSW. There are improving efforts to integrate and share ocean sound data, building with SanctSound.
- Low-cost water level sensors have scaled up in use in IOOS, along with webcams in research to operations. It's becoming more accepted that these can exist along the NOAA navigation accredited data. Both are valuable for local communities.
- SanctSound largely focuses on National Marine Sanctuaries and linking to OSW must be part of future planning (and for Synchro). This is particularly important for better understanding upwelling (natural variability vs turbine impacts).

- CeNCOOS is policy neutral. We will deliver IRA across climate resilience applications in a policy neutral way. Education and outreach will provide additional insights into what the community thinks is important.

Next steps

- Continue scoping with smaller focus groups
- Conduct an aquaculture information needs assessment in partnership with California Sea Grant
- Identify key opportunities to advance CeNCOOS strategic priorities for IRA topic 1 and 2 and beyond

Meeting Background

The Bipartisan Infrastructure Law (BIL, 2021) and Inflation Reduction Act (IRA, 2022) intend to protect and restore ecosystems, reduce marine pollution, enhance climate resilience, and grow the Blue Economy by creating millions of high-quality jobs while ensuring that no communities are left behind (OCAP 2023). The BIL directed $2.96 to NOAA, which included $1.9 billion to restore nationally significant estuaries and tackle hypoxia, improve water quality, and increase resilience across coastal communities (White House Fact Sheet 2022; ICYMI 2022).

The IRA represents the single most transformative action the United States has taken to tackle the climate crisis and create clean energy solutions in U.S. history. Over the next five years, the IRA directs $3.3 billion for NOAA to support preparedness, adaptation, and building resilience to weather and climate events; improve supercomputing capacity and research on weather, oceans and climate; and replace aging NOAA facilities. This, in combination with BIL, will further strengthen NOAA's efforts to build a Climate-Ready Nation.

Coastal, Economic, and Climate Resilience = $3.3B for NOAA over 4 years

- Coastal Communities & Climate Resilience = $2.6B
    - Enable coastal communities to prepare for extreme storms and other changing climate conditions
    - Support natural resources that sustain coastal and marine resource dependent communities
    - Support marine fishery and marine mammal stock assessments

In response, CeNCOOS is engaging with its community to develop plans for a potential temporary increase in funding made available through IRA. We will convene a 1.5 day "Coastal & Climate Resilience" meeting to accomplish the following high-level goals:

Goals/objectives:

- Update the community and gather feedback on feasible, impactful climate resilience activities that promote equity and environmental justice;
- Review existing and emerging high-priority requirements and climate resilience plans to understand what's already included in the CeNCOOS 5-year work plan;

- Hear from partners to understand ongoing activities, synergies, and to avoid duplicating efforts;
- Develop consensus and shared understanding for priority activities, particularly related to new areas of work including water level and ecosystem measurements;
- Engage with partners to understand priorities and opportunities to partner/leverage investment.

Definitions:
Climate resilience: The capacity of a system to retain essential functions before, during, and after a hazard strikes. [NOAA Climate Resilience Toolkit]

Coastal resilience: The ability of populations, ecosystems, and economies to prepare for, absorb, respond to, recover from, and successfully adapt to the impacts of natural and human-caused hazards, such as hurricanes and oil spills and long-term environmental changes, such as habitat loss and sea level rise. [NOS draft definition March 2023]

Equitable service delivery: the consistent and systematic fair, just, and impartial treatment and inclusion of all individuals, including individuals who belong to underserved communities that have been denied such treatment, during every stage of the decision-making process. [adapted from Executive Order 13985]

Nature-based solutions: Actions to protect, sustainably manage, and restore natural or modified ecosystems (land, water, coastal, or ocean) that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits (e.g., coastal protection, reduced flooding, decreased heat-island effects). [OCAP 2023]

Agenda

Day 1 - Wednesday, May 24	
7:30am	Breakfast - Frittatas, yogurt, granola, fruit, coffee/tea
Updates and Climate Resilience Strategies	
8:30AM	Welcome, overview, objectives - Henry Ruhl (CeNCOOS) / John Largier (UC Davis)
8:45	U.S. IOOS - Carl Gouldman (U.S. IOOS, virtual)
9:00	NOAA Office of Coastal Management, Becky Smyth (NOAA OCM)
9:15	California Ocean Protection Council - Mike Esgro (OPC, virtual)

9:30	California Sea Grant - Shauna Oh (CASG)
9:45	Indigenous perspectives - Kashia Band of Pomo Indians (Nina Hapner), Rosa Laucci (Tolowa, TBC), Keith Parker (Yurok, TBC)
10:00	CeNCOOS - Henry Ruhl (CeNCOOS/MBARI)
Session 1: Sea Level Rise, Coastal Flooding, Storm Inundation	
10:15	Supplementing the NOAA NWLON with Partner Water Level Observations Alaska Water Level Watch - Nathan Wardwell (JOA Surveys)
10:20	Web cams – Monitoring inundation - Mark Merrifield (Scripps, virtual)
10:25	Back-yard buoys - low cost wave monitoring - Jan Newton (NANOOS, virtual)
10:30	**Break**
10:45	Discussion - What other programs are operating in this space? What are the existing gaps needed for models/forecasts? Stakeholders? Coastal TWL information conveyance
Session 2: Marine Heatwaves and Extreme Events	
11:30	Forecasts - Mike Jacox (NOAA SWFSC, virtual)
11:35	Products - Andrew Leising, Steven Bograd (NOAA SWFSC, virtual)
11:40	Mobile and push notifications - Shane (Axiom Data Science, virtual)
11:45	Discussion
12:30-1:30pm Lunch break - Gourmet sandwiches, chips, dessert	
Session 3: Ecosystems and Biology, Restoration and Aquaculture	
1:30pm	Kelp - Mike Esgro (OPC, virtual)

1:35	Aquaculture - Luke Gardner (CASG)
1:40	Managed spaces - Andrew DeVogelaere (MBNMS)
1:45	Emerging technologies - Henry Ruhl (CeNCOOS/MBARI)
1:55	MBON and eDNA - Francisco Chavez (MBARI)
2:00	Discussion
Session 4: Commerce and Navigation	
3:00	Fisheries-led observing - Mike Conroy (RODA, virtual)
3:05	Offshore Wind - Jennifer Ise (NOAA NMFS, virtual)
3:10	Products - Jan Newton (NANOOS, virtual)
3:15	Discussion: Prioritization & Process
4:30	Adjourn - On-site reception (Beer/ wine, appetizers)
Optional group dinner at Casino Bar and Grill, 17000 Bodega Hwy, Bodega, CA 94922	

DAY 2 - Community Discussion / Governing Council Meeting

Prioritizing Coastal Resilience Activities	
9:00AM	What's in the 5-year CeNCOOS work plan - Henry Ruhl
9:30AM	What we heard yesterday - Eric Bjorkstedt (NOAA SWFSC) / Mary Miller (Exploratorium)
10:00AM	Discussion: Where are our priorities?
GOVERNING COUNCIL - INTERNAL BUSINESS	
11:00AM	Recommendations: Governing Council to lead
12:00PM	Working lunch - updates from our members
12:30PM	Budget
12:45PM	Membership
1:00PM	Adjourn

PROCEEDINGS SUMMARY

Updates and Climate Resilience Strategies

U.S. IOOS Program Office: New NOAA Strategic Plan (2022-26) includes strategic goals to (1) build a climate + ready nation; (2) make equity central to NOAA's mission, and (3) accelerate growth in information-based blue economy. Increase in funding allocated from the President's budget from 2017-2024. FY23 Appropriations: regional obs = 42.5M, National IOOS: 7.5M Bipartisan Infrastructure Law (prov 3,11,12; e.g. flood inundation mapping, coastal/ocean obs, ocean partnerships). IRA (FY23-26): 3.3B for NOAA for 4 years. 2.6B in coastal communities & climate resilience.

National HAB Observing Network (NHABON) has projects active in all 11 RAs. MBON and the National Oceanographic Partnership Program. HFR Network and Wind Turbine Interference mitigation software. BayCurrents App. HFR modeling (Coast Guard search + rescue). Ocean Technology Transition Program (OTT); funding announcements coming in June 2023. IOOS Advisory Committee; next mtg in June hosted by CeNCOOS @ MBARI. 5M NSF Convergence Accelerator award (Ocean Vision AI).

Office of Coastal Management: Bipartisan Infrastructure Law included 284M for habitat restoration; 492M for National Coastal Resilience Funds: flood and inundation

mapping/forecasting; ~900M for fisheries; Regional Ocean Partnerships: West Coast Ocean Alliance (2M for 2 years) .

There are many sea level rise viewers and visualization in CA. TIde Flooding Products: CO-OPS. Prediction for high tides a year out in beta test. In real-time dashboard. Sea Level rise viewer. Elevation models have gaps in resolution. Partnering with Sea Grant, High-res 1m C-CAP land cover (available June 2023). 13 sea level rise viewers in CA. (Sea The Future: website with information on these tools). Are the tools prepared in ArcGIS or require an API? It depends on the tool, e.g. NOAA Sea level rise viewer is an ArcGIS layer COSMOS tool How to develop collaborations between this group and RAs? This will roll out in the next few years with this new funding; now there is project money (e.g. report cards)

Ocean Protection Council: Work is guided by its strategic plan. Main goals: safeguarding coastal ecosystems, equity, biodiversity, sustainable blue economy. Goal 1: climate change. 6.5M allocated to support coastal resilience. SFEI to coastal habitat map and with NASA for habitats. OAH modeling: human sources of nutrients reducing pH and DO; 30% compression of Southern Bight for 3 months out of the year. Goal 2: Equity. Development of equity plan (communication, outreach, staff training, tribal TEK). Tribal engagement strategy drafted in collaboration with tribes. Goal 3: Biodiversity. Leading implementation of 30x30 framework. Indigenous marine stewardship areas. Decadal review of MPA network; compelling evidence that MPAs are working to protect ocean health. Results will be presented at the upcoming Marine Resource Committee in July. Kelp recovery research program coming to an end. 5M allocated to kelp recovery / research. Microplastics method development and monitoring initiatives. Goal 4: Sustainable Blue Economy. Modernizing data collection, minimizing whale entanglement. Working with the aquaculture leadership team to develop a state-wide action plan to ensure it is managed sustainably. Offshore wind: funding projects that support environmental monitoring guidance.

California Sea Grant: Guided by 2024-2027 Strategic Plan, California Sea Grant implements 4.5M in annual base funding (2023 10% increase) as a cost-sharing program. Funding from UCSD, state programs, private/NGOs, e.g. CA is the largest program in the Sea Grant network. ~50% of funds get allocated to Research Grants and Funding. Wind expert joining the Sea Grant extension program (one in SLO, one in Humboldt). CA Sea Grant RFPs (See sides on specific key topics): Graduate Research Fellowship and Aquaculture Award. National Federal Funding Opportunities; partnered with OPC on kelp recovery, OAH, microplastics. RFPs on behalf of state partners; e.g. Delta Science Awards, CA Water Boards, CA Deep Ocean DDT+. Total Water Level Extremes and Frequency: developing data on coastal floor + fiscal impacts (being used by local policy entities in Southern CA). CA Sea Level Rise report. Sea Level Rise Institute (SLRI) at Cal Poly Humboldt.

Indigenous perspectives (Tolowa Dee-ni', Kashia Band of Pomo Indians): Tolowa cultural keystone species: Pyropia, seaweed, red tailed surfperch, muscles, razor clams, and 1 other. Tribes are concerned about kelp, sea palm, muscles, and take/catch limits. olowa Tribe: Lots of intertidal monitoring, sea star, seaweed survey, HAB monitor, how sea level. Ocean observing

from Smith river. Fill that gap. Get water quality data to fill the gap. eDNA stuff surface smelt in the area. Kashia tribe do similar stuff. HAB sampling. State Parks 3d intertidal modeling. Kelp surveys. Diving with abalone project. eDNA monitoring species TBD.

The coastal environment is a system. Language is based on the landscape, not just one word. This is the place of the coyote descriptive. The place to gather salt in such a language name. Many tribal members know where places within the tribal territory are and how the places are treated. Interest in ocean sounds and acoustics in air and in water. Tribal members, including the Elders, are interested in understanding the coastal ecosystem.In order to prioritize monitoring activities, resource managers ask *what do you miss and what do you gather?* Connecting the tribes with the MPAs that are located close to the tribe enables tribal participation and management. Tribes recognize the important connection between fish that go ocean and river (ie anadromous fish species) and priorities for conservation and restoration. Fish hatcheries can be used to raised salmon and steelhead. Ecological, economic, and subsistence standpoints can vary.

There is ongoing tribal collaboration with Cal Fish and Wildlife and other state and federal agencies around discrete projects. But tribes and western managers don't always see things the same way. For instance, seasonally and throughout history, Tribes will remove some vegetation on the beach to allow for creek/river to connecti to the coastal ocean thereby allowing salmon to come up the creek. State managers see this water divergence but are not seeing the bigger view between systems. Earth will tell you what will happen. Consider the kelp– our marine forests. We are still puzzling things together but what is needed is funding to consider the entire system (including humans) and their interconnection. We need a landscape approach (not this is marine, this is forest, this is mountains). We must consider what washes down to the beach. Some people silo habitats but Tribes realize it is all connected and everything impacts the next.

As tribes begin to collect their data, their needs are in data management before they are willing to share those data. Users might not have access to a database, but when those data do become available, they would already be in a useful format. Integrating indigenous datasets is definitely something that CeNCOOS can help with. GOOS and IOOS working groups / data and metadata standards which we try to implement.

Session 1. Water level and Waves

Low cost 'still' water-level sensors, Webcams, and Backyard Buoys. Alaska Water Level Watch is housed and maintained by AOOS. Online Data Portal, Tide Datums, real-time sensors, other water level obs. Water metadata form w/ data quality information. Online Vertical Datum Transformation (NOAA tool) for accessing elevation data. OTT-funded team is with IOOS grant to develop GNSS (satellite) Reflectometry to determine water levels.

San Diego Imperial Beach project using LiDAR drone, Wave buoy, video camera, water level gauge, and static LiDAR. 57 webcams available in CA. Applications: Bathymetry, identify rip

currents, beach erosion, using AI for beach usage, flood monitoring, visualizing inundation, wind events Lange et al. (2003).

Funded by the NSF Convergence Accelerator program, the goal of Backyard Buoys is to empower indigenous and other coastal communities to collect wave data. Partners: indigenous partners in each region (PacIOOS, AOOS, NANOOS). Using Sofar wave buoys (~$5k cost per buoy), education partners too. Developing app (in prototype), usable in low-bandwidth, messages to share on-the-water observations. Users can set thresholds. Cost = ~$15k per community. If all RAs implemented this, it would cost ~$500k. www.backyardbuoys.org. Broad cost for scaling up has more cost than sustained. What are methods to document them? IOOS can serve the data. Backyard Buoy can fill large gaps in T availability and not nearshore to communities on North Coast CA (from Bodega to Eureka). Kelp forest monitoring lacks high-resolution environmental data, including waves and subsurface temperature.
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Session 2: Marine Heatwaves and Extreme Events

Products, Forecasts and Mobile and push notifications.
Marine heatwave products can be found on the Blobtracker Website (every day showing SST anomaly). Also showing long-term numbers in % EEZ cover (and last 6 months). Data on spatial variability across the west coast. CCIEA Indicators Dashboard interactive timespans, can overlay with other variables (e.g. upwelling). It serves out a more detailed look at indicators (% cover, intensity, HW distance, sum intensity) and is updated every 6 months. Data is archived on ERDDAP, animations also available. Wind and sea level pressure overlay coming soon. Using WCOFS to calculate those metrics is also being progressed.

NOAA PSL's https://psl.noaa.gov/marine-heatwaves/ serves global monthly observations of marine heatwaves. Can click any location to get a time-series of SST anomalies colored by heat waves at different thresholds. Global monthly forecast layers also available: forecast methods in Jacox et al. (2022). Users a can click on a particular point to get probability.

Push notifications were discussed to alert users of real-time environmental status on user defined thresholds; many interested types of users. There is a proposed technical approach (see slides w flow chart). Potential features: Register / manage own alerts, set thresholds. Suggest threshold values based on historical data.Potential issues include : Alert/mgmt fatigue, and unintended harm/liability. Suggestions included making the system as simple as possible in early stages; start with very simple datasets

Alert fatigue; is there a best practices guide to work from? This will be part of the development process; collecting metrics and dispatching those. Axiom uses some existing tools internally that are customizable for how they get alerts. Users can define them for themselves. We could add some common options or standards with customizable control. Questions arising include: How would coastal communities interface with large scale? How could they get more engaged? Explain how data goes into the model and is used on these forecasts.

Modular Ocean Model (MOM6) model uses a ROMS based model covering a large region including US West Coast and Alaska. There is hope next year will have beta forecast data available. It may be operational level similar to WCOFS in 2025. And there is work on a regional implementation. The result is intended to improve climate information in fisheries. MOM6 will underlay this with large regional grids that can also be used to have long term climate predictions. West Coast is behind east coast versions. There is NOAA investment in this. Mobile apps and put into mobile friendly with portal data.

ENSO is the largest predictability signal for the California Current. Largely we are dealing with a communication issue. How do you communicate something like that (a system that is useful but not always perfect). There are a lot of links between heatwaves and upwelling. We hear a lot of questions about these links from stakeholders. Product delivery around upwelling and seasonal OA. The OA community looks to the heat wave community for extreme event definitions, and data quality challenges. Is there an audience within the aquaculture industry for improved information products. Putting likelihoods into communication makes it difficult. We have been working on how best to visualize the El Nino indices.

Push notifications will be important for the aquaculture community. Data needs to be distilled down. There is tons of scientific information out there not getting to end users because the communication is challenging. Push notification could even just be a warning, not necessarily raw data. Starting simple is probably best. MOCI index is generated more regularly now (quarterly product).The issue is the lag; the data is archived years after managers might want it. Shane: Building an UI is doable but is very complex. There are certain cases where there is a known connection between multiple parameters, we could group them together. E.g. Aragonite Saturation State calculations on gliders.

There was discussion of context to HABs and alerting and IFCB to near real-time. Now that we have the IFCB network, we are in a place where automated products go out to managers. Daily HAB taxa compared to last week or two. There are regulatory and legal concerns for them to make decisions for managers to make measurements for regulatory alerts. HAB sampling builds out of a picture of context. CoastWatch is also considering real- time alerts to share about HABs events happening and those on the way. Should include information on toxins but data sparse.

Session 3: Ecosystems and Biology, Restoration and Aquaculture

Kelp, Aquaculture, and Managed spaces.
Kelp Action Plan (OPC + Dept of Fish and Wildlife) drove investment of over $3.5M. Launch of CDFW Kelp Restoration and Mgmt Plan. $5M this year to accelerate kelp research and restoration. Kelp is a huge priority of the region. Intertidal and kelp work. PISCO data already in CalOOS Portal. Kelp issues tracks sea urchin issues. Drones might be more important to use to get more detail in canopy information.

There are needs from the aquaculture community for ground truthing environmental observations linked to aquaculture issue events. Is the information I am receiving warranting action from the shellfisheries manager? E.g. summer mortality syndrome. Need for improved monitoring for permitting compliance; this is typically expensive for farmers (eutrophication, public health, etc.). Information accessibility to the average farmer; needs to be more accessible but it takes effort to do this. Will aquaculture make us more resilient? Grow to outplant the ones that can be more climate tolerant. What is the capability of aquaculture to look for resilience? This work is very nascent. Can a species be more heat tolerant? This wades into genetic selection and ethical questions of whether we should be changing the population. Rearing endangers or threatened species in a laboratory then restoring populations in the environment to provide ecosystem service. A lot has been promised and theorized, but not a lot of work has been achieved. Are these claims valid? Should the benefits of conservation aquaculture to the environment help them to get permits easier.

Aquaculture for CO2 removal and other technologies are likely to perturb the natural system in some way. Observing systems could monitor these perturbations and maybe help predict what some of these changes might be? A lot may be pure R&D and not low cost. CeNCOOS has ordered its first Spray 2 with a full BGC payload and will build out gliders with this. CeNCOOS also expects to build a passive acoustic network using Spray 2. Merge biology, chemistry and physics. Work with drone data to get images data portal to trial in geoserver format, but is . likely to fund a fleet of drones but could facilitate data from other drones. Camera's could progress in monitoring of sensitive areas such as for OSW.

Additional opportunities for CeNCOOS IRA topics discussed included: Ocean obs (IOOS), habitat restoration, wetland monitoring, tribal collaboration, stock assessments (e.g. whales + ships). Linking marine heat waves with biological data (e.g. using animal telemetry data). Supporting new marine managed areas: Chumash Heritage National Marine Sanctuary, 30x30 effort, Wind Energy regions, Deep-sea coral sites. Enhance existing partnerships SandSound, CalCOFI, minimizing overlap of whales, ships, etc..

Emerging technologies, MBON and eDNA.
Synchro tech testbed has 3 pillars: Testing/evaluation access for tech, Low-cost sensor exploration, and a pilot study for monitoring offshore wind impacts. Expected to include eDNA, imaging, PAM, tagging. SanctSound; data available through Axiom portal. Planktivore: phytoplankton imaging system on a LRAUV, leveraging Ocean Vision AI. How to incentivise this to move to new methods? There is risk in losing funding streams after IRA ends if using emerging tech. Drones, underwater with AI to shape and species abundance. Combine with eDNA to look at what is happening. Imaging on gliders is still a bit far off but still in research. Not in the low cost space. There are more and more people that can do AI work. CeNCOOS is working on nurturing these things in parallel including demonstration to users. However, we can't do all the stuff on our list. Prioritizing some things is necessary.

CeNCOOS MBON funding started in 2014. qPCR (targeted species), NGS (look at population genomics). eDNA national strategy manuscript in press (Kelly et al); implementation plan in the

works by federal groups. 1B needed to implement national/west coast infrastructure (collection, processing, information system, data mgmt, products). CeNCOOS can play a leading role in data mgmt and products. One of most important steps is the taxonomy assignment (esp when species- level genomics does not exist in reference database)

How should we organize eDNA data now? There are data gaps for months to year process eDNA. Is eDNA scalable and automated ways to do that? MPA surveys dives to process eDNA compared to traditional techniques. We can get much higher temporal resolution of imaging and data collection. Using eDNA in kelp forest can find kelp gametophytes if urchins are not there. How long would they persist with urchins there?

The urchin issue. Effort to fatten them up to give them economic value. Incentivise to remove them. How many to take and where to take them from? Can we use drones to map urchin barrens? What is the magic number to remove to get kelp to come back. How long do propagules last? Do we need kelp hatcheries? Benefit from aquaculture avenue for public access and engagement. Advocate for funding. How can environmental measurements be useful. Fort Bragg Noyo Center now has instruments on site to look at water quality in Noyo harbor/river to know if organisms can grow in that environment. The plan is to collect a two year water quality record to make sure conditions are okay to grow. There is also concern about sea level rise in area.

Multi-trophic aquaculture holds promise but is not happening at scale in California. Still not a lot of research and often co-occurrence is accidental. Fish farms that also require and grow seaweed, filter feeder farms also look to seaweeds nearby. Can be used as a mitigating factor if growers can show avoidance or mitigation technique. Need observations to demonstrate growing seaweeds onsite actually helps. Consideration of co-locating mariculture with offshore wind? A tiny bit of discussion happening. There are a number of examples in Europe (Germany). Many mitigate offshore wind impact. Talked about and then dismissed (sort of 2 skunks at the garden party analogy). Seaweed as carbon sequestration? Oyster is easier to expand to kelp than fin fish. Generally yes? Now it is very hard to add to a farm have to go through a full blown permitting process. Existing farms which have existing infrastructure can serve as aquaculture innovation sites.

Session 4: Commerce and Navigation

Offshore wind, Fisheries-led observing, Products.
In California, we're looking to develop 30 GigaWatt goals from the federal government from offshore wind. 20GW more needed to achieve 25GW stategoal (likely future siting in N Cal). Currently, Humboldt: 2 leases, Morro Bay: 3 leases. NMFS provides recommendations to BOEM, Endangered Species Act consultations for proposed offshore wind activities, essential fish habitat for permitting. Also providing data used for decision making (fish stocks, NMFS scientific surveys). 5 species are in the spotlight: leatherback turtles, gray whales, abalones, 2 salmon species.

Needs: short-term observations to inform consultations, long-term to understand impacts and inform adaptive mgt. Developing NMFT West Coast OSW science plan Regional science collaborative forming, modeled after east coast work to bring together govt, ngos, academics to talk about monitoring needs, prioritize research. CA Assembly Bill 80 calls for OPC to lead such an initiative. CA OPC put out an RFP for env. monitoring. Summit in August. Potential impacts in discussion: Oceanographic/ atm changes, Artificial reef changes, fish aggregations, Impacts to different life stages (e.g. larval dispersal), and Sound, electromagnetic field (EMF). Not one coordinated process yet, including for regional monitoring. Not just NFMS and BOEM, but state and tribes etc., BOEM and NFMS have created a joint survey on the east coast.

Fishermen can help to monitor offshore and unseen conditions. Is anyone using fishing boats for real-time data? Southwest Fisheries Centers fill data gaps in the nearshore for data gaps related to sardine and anchovies. Dungeness crab fisheries are working to reduce entanglement. Deep set gear for swordfish. Distrust in fishing and those not in the community. An avenue to rebuild that trust for Winds, Whale entanglement. Models can also be used to fill data gaps. Collaboration with fisheries underwas for rockfish through MPA monitoring programs. Oregon deploys o2 sensors on crab traps. NOAA has hosted seminars on the use of fishing nets to get data. In SF bay, interest in crowdsourcing visibility data to validate sensors.

Work on co-collection of data? How to link chemical data to phytoplankton. How to work in best practices for OA and Biological data. Things evolve and usually it costs money. Have to find funds to sample correlated biological and physical data. Some marine heatwaves are not the scale of MPA but at Sanctuaries. Estuaries not able to collect biology and physics at the same scales. How quickly can we get the data out? Reports get data out faster than 10 years. Simple graphics are getting better.

How to use urchins that don't have much value and raise in a way that they could have value. Need to educate the fishing community; e.g. ocean acidification is not a topic of discussion among fishing communities. Fisheries knowledge is being underutilized. Advocating for a slow approach and adaptive management for offshore wind. Concern on loss of fishing grounds and unknown impacts to fish, marine mammals, upwelling, larval distribution, etc. Partnering with the fishing community for OPC RFP is recommended.

NVS Boaters App and Maritime Ops App were developed with user groups and community workshops. There is functionality; e.g. adding waypoints, marina information, customizable units, snapshot tool to save a data view, comparing model vs obs. It was launched in 2005/2007 and they hear a ton. Have some of the Canadian stuff. Get contacts. Go to yacht clubs and sportsman shows. Contact us to get a response. They do not get any revenue from boater app– safety is free of charge.

Participants (Invited)

Name	Organization	Governance	Attend?
Abby Gomes	Kashia Band of Pomo Indians	Partner	N
Alex Parker	Cal Maritime Academy	Governing Council	N
Andrew DeVogelaere	NOAA Monterey Bay National Marine Sanctuary	Governing Council	Y
Andrew Leising	NOAA SWFSC	Partner	V
Andrew Moore	University of California Santa Cruz	Principle Investigator	N
Bret Folger	NOAA OCM	Partner	N
Carl Gouldman	US IOOS	U.S. IOOS	V
Chad Whelan	CODAR	Principle Investigator	Y
Chris Edwards	University of California Santa Cruz	Principle Investigator	V
Clarissa Anderson	Scripps Institution of Oceanography Southern California Coastal Ocean Observing System	Partner	V
Corey Garza	California State University, Monterey Bay	Governing Council	Y
Daniel Swezey	UC Davis	Partner	Y
Dean Wendt	Cal Poly State University, San Luis Obispo	Governing Council	N
Emily Bockmon	Cal Poly State University, San Luis Obispo	Principle Investigator	N
Eric Bjorkstedt	NOAA SWFSC	Executive Committee	Y
Francisco Chavez	Monterey Bay Aquarium Research Institute	Executive Committee	Y
Henry Ruhl	Central and Northern California Ocean Observing System	Staff	Y
Jack Barth	Oregon State University	Principle Investigator	V
Jaime Jahncke	Point Blue	Governing Council	Y
Jan Newton	Northwest Association of Networked Ocean Observing Systems (NANOOS)	Partner	V
Jeff Abell	Cal Poly Humboldt	Principle Investigator	N
Jenn Eckerle	OPC	Partner	N

Jennifer Ise	NOAA NMFS	Partner	V
Joacquelyn Overbeck	NOAA	Partner	V
John Largier	University of California Davis	Governing Council/PI	Y
Josh Cahill	Yurok Tribe	Partner	N
Justine Kimball	California Natural Resources Agency Ocean Protection Council	Governing Council	N
Kevin Johnson	Cal Poly State University, San Luis Obispo California Sea Grant	Partner	N
Keith Parker	Yurok Tribe	Partner	N
Kristen Yanarsek	IOOS Association	U.S. IOOS	V
Laura Engeman	CASG	Partner	N
Laura Rogers-Bennett	California Department of Fish and Wildlife UC Davis	Governing Council	N
Laurie Richmond	CASG	Partner	N
Libe Washburn	University of California Santa Barbara	Partner	V
Liz Whiteman	Cal OST	Governing Council	V
Luke Gardner	CASG	Partner	Y
Lynn Dewitt	NOAA SWFSC	Governing Council	Y
Marisol Garcia Reyes	Farallon Institute	Principle Investigator	Y
Mark Merrifield	Scripps Institution of Oceanography	Partner	V
Mary Miller	Exploratorium	Executive Committee	Y
Megan McKinzie	Animal Telemetry Network	Staff	Y
Megan Medina	Scripps Institution of Oceanography Southern California Coastal Ocean Observing System	Partner	N
Michael Jacox	NOAA SWFSC	Partner	V
Mike Conroy	Responsible Offshore Development Alliance	Partner	V
Mike Esgro	OPC	Partner	V
Nathan Wardwell	JOA Surveys	Partner	Y

Nick Rome	NANOOS/COL	Partner	N
Nina Hapner	Kashia Band of Pomo Indians	Partner	Y
Raphe Kudela	UC Santa Cruz	Executive Committee	Y
Rebecca Smyth	NOAA OCM	Partner	Y
Rob Bochenek	Axiom Data Science, A Tetra Tech Company	Principle Investigator	V
Rosa Laucci	Tolowa Di-nee Nation	Governing Council	Y
Roxanne Carini	NANOOS	Partner	N
Ryan Walter	Cal Poly State University, San Luis Obispo	Principle Investigator	N
Shauna Oh	California Sea Grant	Partner	Y
Steven Bograd	NOAA SWFSC	Partner	V
Tom Connolly	Moss Landing Marine Labs/SJSU	Principle Investigator	V