Ocean Protection Council Science Advisory Team (OPC-SAT) Meeting

November 19, 2012

At the Gordon and Betty Moore Foundation

1661 Page Mill Road, Palo Alto, CA

10:00 AM to 5:00 PM

Meeting Summary

Meeting Attendance

OPC-SAT Members: R. Ambrose, A. Boehm, M. Carr, K. Coale, , J. Fields, G. Griggs, S. Johnson, M. Hall-Arber, K. McLeod, S. Murray, K. Nielsen, J. Stachowicz, and S. Weisberg

State Staff: S. Flores (OPC), D. Gregorio (SWRCB), J. Laird (Natural Resources Agency), C. Kuhlman (OPC), C. O'Reilly (OPC), V. Termini (OPC), and S. Toews (OPC)

Guest Speakers: F. Chan (OSU), R. Feely (NOAA/UWA), D. Keehner (U.S. EPA), and J. Newton (UWA)

OST Staff: T. Freidenburg, E. Knight, E. Kramer-Wilt, S. McAfee, A. McGregor, E. Meyer, R. Meyer, H. Rindge, L. Whiteman, and H. Zemel

Part 1: *Meeting Introduction*

Welcome and Agenda Overview

SAT Executive Committee, including S. McAfee, A. Boehm, G. Griggs, and M. Carr welcomed everyone to the meeting, and provided an agenda overview. B. Gold, Program Director for the Marine Conservation Initiative at the Moore Foundation, also welcomed the SAT, providing a few brief remarks about his role as member of Ocean Science Trust's (OST) Board of Trustees, the work of the Moore Foundation, and his perspective on the importance of connecting science to policy and management.

C. Kuhlman described the charge from the Ocean Protection Council (OPC) to the OPC-SAT and OST to build an ocean acidification and hypoxia science panel. Kuhlman highlighted the primary goals of the day, which were to get input from the SAT on building and managing the panel, and to give OST ideas on how best to inform resource managers as they plan for and management the threats of ocean acidification and hypoxia.

Opening Remarks from Secretary John Laird, CA Natural Resources Agency

Introduced by C. Kuhlman, Secretary John Laird provided insightful remarks on the role of science in government, the effects of the current fiscal situation, the near completion of the statewide network of marine protected areas (MPAs), and his vision for ocean governance in the state. In summary, Secretary Laird discussed:

- How the passage of Proposition 30 has created breathing room to focus on other issues.
- His vision for a fully unified ocean program in the state; the first step being the integration of the OPC and the Ocean Resources Management Program, which previously were distinct, under the management of C. Kuhlman.
- Some critical appointments in ocean management, namely Cat Kuhlman as Deputy Secretary of Ocean and Coastal Matters, and Chuck Bonham, Director of the Department of Fish and Game. Both bring unique perspectives to ocean management. For example, as a former water quality regulator, C. Kuhlman brings a deep understanding of the land sea interface. C Bonham in his previous role as Director of Trout Unlimited was intimately involved with helping to negotiate the Klamath Restoration Agreement.
- Ocean priorities facing the state, including climate change, marine debris and MPAs. The Secretary raised the question of how best to talk about these issues in ways that bring together the realms of public policy (and politics), the scientific community, and the challenges ahead. The Secretary sees his role as laying the policy groundwork for these core topics, including working with stakeholders from across the spectrum to build meaningful coalitions, and educating the public.
- The ocean acidification and hypoxia science panel charge. Secretary Laird emphasized the importance of the panel, and reaffirmed the Governor's commitment to giving science a seat at the policy and management table.

Q&A with Secretary Laird

- *G. Griggs asked about strategic opportunities to inform the legislature?*

Secretary Laird emphasized that communications is key because they work on extremely short timeframes. Secretary Laird suggested first understanding legislative priorities to identify where opportunities might be, and to distill your message to four or five brief bullet points.

- *A. Boehm asked about the role of science in resolving political conflicts, specifically those situations where there is opposing information from different scientific disciplines?*

Secretary Laird recommended that scientists do their best to reach consensus prior to bringing the information to decision-makers. However, he recognizes that this is not always possible and so it is critical for a body like the SAT to help decision-makers wade through the complexity, and understand tradeoffs.

- *K. Nielsen asked the Secretary for an example of a situation where scientific consensus was presented in a beneficial way.*

Secretary Laird highlighted then Senator Al Gore's explanations of climate change to the public in 1989. His willingness to engage the public did lay the foundation for practices to change on a variety of scales. That said, often it is impossible to predict how the public might respond to a new topic and what, if any, political or policy progress. Secretary Laird related progress in the political realm to "jumping out of the plane while the parachute is still being designed."

- *A. Boehm concluded the session with asking the Secretary what his top three questions would be for the ocean acidification panel?*

Secretary Laird said he'd like to understand the top two or three factors that are driving ocean acidification; the top two or three impacts of greatest risk; and the most valuable ways to talk about ocean acidification with the public.

Part 2: Working Session

Ocean Acidification and Hypoxia: Engaging California in the Challenge

A. Boehm, who will serve as chair of the ocean acidification and hypoxia science panel, introduced the session by setting out the goals:

1. The OPC-SAT will develop a shared understanding of the science and management landscape related to acidification and hypoxia, and related implications for building the expert panel in California.
2. Based on this understanding, the OPC-SAT will brainstorm ideas for consideration by OST in developing the expert panel.

Ali Boehm then offered one overarching question to guide the SAT's work:

- Considering what you learn today, how would you constitute, scope, and manage a science panel to inform state decision-makers?

A. Boehm concluded by encouraging the SAT to think creatively, and that OST would be drawing upon the SAT's discussions to develop the scope, work plan, membership and structure for the expert panel.

Sub-Session #1: WA State Ocean Acidification Blue Ribbon Panel

A. Boehm described how the State of Washington convened the WA State Ocean Acidification Blue Ribbon Panel earlier this year. The panel was initiated as part of the WA Shellfish Initiative, and charged with documenting the current state of scientific knowledge on ocean acidification, identifying ways to advance scientific understanding of the effects of ocean acidification, and recommending actions to respond to increasing ocean acidification, reduce harmful effects on Washington's shellfish and other marine resources, and adapt to acidified waters. The sub-session goals were to (a.) get an overview of the panel's work and findings, and how this effort is informing management; and (b.) identify lessons learned that might be transferable to California in developing our own expert science panel.

Speakers:

Richard Feely, Senior Scientist, National Oceanic and Atmospheric Administration/PMEL Carbon Program, Professor of Oceanography, University of Washington

R. Feely opened his presentation by describing the most recent advancements in our understanding of ocean acidification, and identifying some of the critical knowledge gaps facing managers and scientists. For example, Feely emphasized the need to create a budget for human and natural drivers of ocean acidification, including the myriad of sources of CO2, including local vs. larger scale contributions, and how this may be magnified by coastal upwelling, and other factors such as nutrient and organic matter inputs. R. Feely went on to highlight the California Current Acidification Network (C-CAN) in confronting such challenges. C-CAN is at the forefront of thinking through how best to measure ocean acidification in a standardized way, and identifying existing physical and intellectual assets to lay the groundwork for a coordinated network. Feely noted that C-CAN is an unparalleled opportunity for the West

Coast to advance understanding in a unified way, and provide credible and timely data and products for adaptation planning and implementation.

R. Feely then provided an overview of the Washington State Ocean Acidification Blue Ribbon Panel. Feely noted that the panel had 28 members, including state managers, tribes, scientists, legislators, federal scientists and stakeholders. The panel produced two primary reports, the first a science summary of our most current understanding of the issue, and the second the final report (which was released on November 27, 2012).

R. Feely then summarized some of the early actions recommended by the panel (for a complete list see the final report):

- Slow pace of acidification by reducing emissions, including local sources.
- Reduce local nutrient and dissolved carbon contributions to acidification – R. Feely noted this is a huge data gap.
- Flexibly adapt, and where necessary, remediate the impacts, especially because conditions are changing so fast. R. Feely noted that by 2050, corrosive waters will be far more extensive. Adaptation strategies that work now may not work later – must have stepwise approach.
- Strategically research, model and monitor marine waters and species. R. Feely noted that there are not any state or federal agencies tasked specifically with researching and developing adaptation strategies. This makes developing a research program for actionable science a challenge.
- Educate the public about the consequences of ocean acidification to our region.
- Support and facilitate implementation of Panel's recommendations at the state level, but with an eye toward regional and federal coordination. R. Feely emphasized that it is key to vision next steps early on, including potential roles for the West Coast Governors' Alliance (WCGA), C-CAN, and reaching out to Alaska and British Columbia.
- Reduce other stressors, such as pollution and storm water runoff and erosion, to name just a few.

R. Feely concluded his presentation with a few reflections for California to consider. Ocean acidification must be monitored at various scales, especially the estuaries and coastal areas. C-CAN is a great body for this, as well as fostering a collaborative spirit among the scientific community. The WA State effort was very collaborative in terms of bringing together stakeholders, managers and scientists. However, there were some scientific disciplines that we did not have, including a biologist, namely with expertise in physiological responses of organisms and genomics, or a social scientist.

Jan Newton, Senior Principal Oceanographer, Applied Physics Laboratory, University of Washington

J. Newton's presentation focused on ways to understand drivers of ocean acidification at more local scales in complex coastal environments. It will be critical for the expert panel to take into account and communicate to decision-makers how the distinctive characteristics of the CA coast contribute to (or ameliorate) ocean acidification. In the Washington State effort, they chose to break the state's aquatic environment down into a series of sub-regions, including ocean

and coastal, the Puget Sound and Strait of Juan de Fuca, the Columbia River, and shallow estuaries, then described the unique characteristics of each and how those characteristics interact with the variety of drivers of ocean acidification.

J. Newton went on to recommend that monitoring strategies be diverse, coupling physical/biological/chemical observations in order to track the range of impacts. Collaboration will be key. For example, the Northwest Association of Ocean Observing Systems (NANOOS) harnessed existing sensors in place by the University of Washington and the National Oceanic and Atmospheric Administration (NOAA). Partnerships with stakeholders were also built, such as the Pacific Coast Shellfish Growers Association (PCSGA) Monitoring Program. The next steps will be building on these assets, as well as blending the data streams and offering it across communities.

Finally, J. Newton highlighted the memorandum of understanding (MOU) between NANOOS and the Central and Northern California Ocean Observing System (CeNCOOS), and the Southern California Coastal Ocean Observing System (SCCOOS) to work on ocean acidification West Coast wide. As a result, the three have been working through C-CAN to compile a preliminary inventory of pCO2, total CO2 and alkalinity measurements. J. Newton concluded by saying that with its emphasis on partnerships across the scientific, management and stakeholder spectrum, C-CAN is emerging as the premiere forum for integrating existing data, and identifying and prioritizing data needs.

Discussion: WA State Ocean Acidification Blue Ribbon Panel

Discussion centered on how California can build off of, or complement the WA Blue Ribbon Panel effort, including the kinds of scientific gaps or questions California might consider, the structural elements California may want to replicate, and lessons learned, among others.

- *Panel Scope*

WA State took on a comprehensive effort by incorporating onto the panel a wide range of entities, including scientists, managers, stakeholders, tribes and industry. While this made the panel process extremely interactive and engaged, it entailed a huge amount of work. California has asked primarily for a science panel to help the state understand ocean acidification. Therefore, a critical task early should be to articulate and make publically available a detailed charge and scope for the panel in a way that also clearly bounds the panel's work. This will help to determine core structural elements such as panel composition and timelines, including milestones and metrics of progress.

- *Structural Elements*

In WA State, the Blue Ribbon Panel was the main body with broad representation. Under it were a series of sub-groups that included a science sub-group. First, while representation on the science sub-group was multi-disciplinary, two gaps were (a.) a marine biologist with specific expertise in physiological responses of marine organisms to changing conditions and genomics, and (b.) a social scientist of some kind (depending on California's particular need). Second, it was recommended that California include scientists with diverse experiences or affiliations, such as academic scientists alongside scientists from agencies or non-profits, and those who understand traditional ecological knowledge and culture.

For WA, the timeline for a final product was determined at the outset, and extremely accelerated. In California there is a similar urgency, however, a specific end date has not been

set. First, the core questions to the panel should be drafted and used to inform a timeline that includes panel products and their intended release dates. Second, flexibility should be built in, to enable the panel to respond to needs or questions that arise later.

Finally, R. Feely and J. Newton advanced a question to the SAT that they and their colleagues regularly grappled with, which was – where to go from here? In other words, they suggested that California consider from the beginning ways to ensure that panel product(s) have impact far beyond the panel's life span. They emphasized that the panel should not just synthesize and translate the most current science, but seek opportunities to inform specific management decision-points and catalyze other efforts going forward.

- *Knowledge Gaps*

In the course of their work, the WA State effort identified a variety of knowledge gaps California might consider filling. The diversity of drivers (both human induced and natural) of ocean acidification; vulnerability of organisms and various habitats; adaptation studies; and estuary processes, to name just a few. Understanding the latest knowledge of ocean acidification along the California coastline could be a nice complement to the work done on WA, especially if done with eye toward West Coast wide coordination. The first product of the California panel should be a review of the WA effort – identifying the information that is applicable here, and articulating next steps.

Sub-Session #2: Hypoxia along the West Coast

The goal of this agenda piece was to update the SAT on advancements in understanding of hypoxia along the West Coast so that the SAT could later discuss how best to incorporate hypoxia into the panel charge.

Speakers:

Dr. Francis Chan, Assistant Professor Senior Research, Oregon State University

F. Chan began by describing that hypoxia is regional-scale pervasive feature of the California Current, an ecosystem that is extremely sensitive to changes in oxygen. Source water and wind-forcing variability are proximate drivers of hypoxia. It can be seasonally persistent along the coast, and extend across the shelf (where it may occupy about half the water column). However, F. Chan noted, it appears to be getting reset by climate change. Scientists are now seeing these low oxygen zones spread, leading to the core question: how will climate change impact this phenomena, and what are the best ways to track this?

F. Chan also described the potential ecosystem impacts of hypoxic events. For example, a variety of fished species are vulnerable, including Dungeness crab, rock fish and ground fish. In many cases a population will be devastated by an acute event, however it remains unclear the extent of community level impacts, or the stages of recovery. F. Chan also discussed the potential for feedback between changes in oxygen and then other elemental cycles.

Finally, F. Chan emphasized that this is extremely complex, especially with respect to tracking source water. Scientists have been measuring since the early 2000's, and climate dials seem to have a strong sway on low oxygen zones at least along the Oregon coast. However, there is a lot of inter-annual, inter-decadal, and other variability that must be accounted for. Further, F. Chan suggested that ecosystem scale information on the coupled expression of hypoxia and ocean acidification could play a key role in understanding if this already impacts species,

ecological communities, and biogeochemical cycles.

On a positive note, F. Chan highlighted that a variety of efforts have been aggressive in investing in infrastructure and programs to help construct a more detailed picture of our coast line, including how currents flow, and how that impacts biogeochemistry, wave energy, and oxygen climatology. Science networks, such as C-CAN, the Ocean Margin Ecosystems Group for Acidification Studies (OMEGAS), and the ocean observing systems are critical for collecting and disseminating data.

Sub-Session #3: Management Perspectives on Ocean Acidification

The U.S. Environmental Protection Agency (USEPA) has issued a memorandum to provide guidance to the states and regions in addressing ocean acidification under Sections 303(d), 305(b) and 314 of the Federal Clean Water Act (CWA). Under the CWA, states have primary responsibility for protecting and restoring surface water quality, and in California the State Water Resources Control Board (SWRCB) performs this task. In this sub-session, water quality managers described the challenges to regulating ocean acidification at the federal and state levels, and discussed the kind of scientific information that would be helpful in approaching this complex task.

Speakers:

Denise Keehner, Director, Office of Wetlands, Oceans and Watersheds, U.S. Environmental Protection Agency

D. Keehner gave a primer on the CWA framework and the ways in which it can be applied to address ocean acidification and hypoxia. While there is existing authority under the CWA to act, there are a lot of science needs that must be resolved first. Two areas of significant uncertainty include linking upstream impacts with downstream effects, and the tradeoffs surrounding various control mechanisms. Relevant sections in the CWA are:

- 304(a) – EPA's authority to publish water quality standards;
- 303(c) – states' authority to adopt water quality standards (within 3 miles of the coast); and
- 303(d) – states' requirement to develop a ranked list of impaired waters and develop total maximum daily loads (TMDLs).

D. Keehner went on to note that the EPA memorandum declares that if states have data demonstrating that a body of water is impaired because of ocean acidification, then they must submit that data to the EPA. The EPA is currently working with a variety of states to review data, however data is largely absent or limited at this time. The EPA is also engaged on ocean acidification through other venues, including adaptation planning as part of the National Ocean Council, and supporting research.

Hypoxia has long been one of the EPA's priorities. D. Keehner said the EPA is collaborating with other federal agencies (e.g. USDA), a variety of states, and local entities to develop nutrient reduction frameworks and numeric nutrient criteria, and to make information more readily accessible to stakeholders.

D. Keehner concluded by describing the key challenges to addressing ocean acidification:

- While most states and territories have marine pH water quality standards (criteria), they

were not developed to specifically address ocean acidification impacts;

- the majority of coastal states and territories lack water quality standards for carbon parameters; and
- many coastal states do not have bio-criteria or bio-assessment methods for organisms vulnerable to ocean acidification.

Priority information and data needs include:

- Water body-specific data to quantify the pH baseline (definition of 'natural');
- information on the biological response and population consequences for vulnerable species and communities;
- science support for the development of water quality standards for carbon parameters;
- research on the synergistic effects of emissions and nutrient pollution; and
- equipment for pilot monitoring programs.

And finally, challenges associated with managing hypoxia:

- Sourcing nutrients is extremely difficult and costly (and often far from the impacts);
- as is coordinating nutrient reduction activities across boundaries (state or other jurisdictions); and
- the lack of state numeric water quality standards for nitrogen and phosphorous.

Dominic Gregorio, Manager, Watersheds, Ocean and Wetlands Section, Division of Water Quality, State Water Resources Control Board

D. Gregorio opened with briefly summarizing the regulatory jurisdiction (inland surface waters and out to 3 miles offshore) of the SWRCB, which receives its authority from the CWA and the Porter Cologne Act. The SWRCB is supported by 9 regional boards that implement and enforce water quality standards through a series of basin, or watershed plans. D. Gregorio went on to explain that with respect to pH, a body of water can't exceed more than 0.2 units of the natural pH. However, there is not a clear definition of what "natural" means. For hypoxia, the trigger point is a 10% decrease in dissolved oxygen.

D. Gregorio explained that the scientific data isn't there yet to properly manage ocean acidification. The majority of measurements come from sewage treatment plants, with larger plants conducting measurements once a quarter and smaller plants once a year. Often measurements do not cross the 0.2 change threshold. However, the instruments being used often lack sufficient sensitivity to confidently measure pH changes of less than 0.1 units.

D. Gregorio concluded by saying that more data would help significantly, and the SWRCB is working with such entities as Scripps Institution of Oceanography (Professor Andrew Dickson), the SCCWRP, CeNCOOS and SCOOS. However, funding is limited – so collaborative efforts that pool both physical and intellectual assets are crucial.

Discussion: Management Perspectives on Ocean Acidification

- *Existing Data Sources & Infrastructure*

D. Keehner and D. Gregorio agreed that it is already known that higher quality data is needed. D. Gregorio also reiterated that much of the data is collected by treatment plants to varying degrees, however, this does not account for non-point source pollution. It would extremely helpful to know what sensors are out there, the kinds of data that are being collected, especially if there are any long-term data sets. From a scientific perspective, this will help identify data needs and priorities, and articulate a research agenda. From a management perspective, it will help to develop reasonable information thresholds for decision-making and day light areas of uncertainty.

- *Management Thresholds*

Water quality managers do not expect uncertainty to be completely eliminated before they can meaningfully act. They work to get the best available science, assess what is coming, and then apply the precautionary principle. What is more challenging is enforcement. Water quality managers have to be able to link it to a discharge somewhere. This can be a challenge for point source pollution, and is nearly impossible for non-point source. Other challenges are administrative burdens – for the state to change a water quality standard, they must go through a CEQA (California Environmental Quality Act) process, which takes 2 to 3 years. This raised a crucial recommendation – identify areas where good data exists, and use that information to empower those already working to reduce pollutant loads.

Participants concluded with discussing the audiences, or "clients," for the panel's products. Should the panel focus on management, or be public facing? This has implications for how the panel approaches translating the science, and the communication support that OST will need to provide.

Sub-Session #4: Some Elements of the Broader Context

CA Current Acidification Network (C-CAN)

The final presentation was a brief summary of C-CAN, provided by C-CAN chair, S. McAfee, and S. Weisberg, who has been a participant since its inception. C-CAN was initiated when the shellfish industry became concerned about the impacts of ocean acidification to their industry, and reached out to the Southern CA Coastal Water Research Project (SCCWRP) to better understand the science. C-CAN quickly grew, involving not just the West Coast shellfish industry and scientists, but also managers and other thought leaders. Its goal is to explore what is causing shellfish losses on the Pacific coast, including what role ocean acidification and other factors are playing. Currently in its early stages, C-CAN is beginning to identify and link existing physical and intellectual assets that could contribute to our collective understanding of ocean acidification. C-CAN is also developing protocols around such core components as building a database, standardizing data collection and equipment – to ensure that efforts advance on a unified front.

S. McAfee and S. Weisberg concluded by stating that there is tremendous potential in a mobilized and responsive network. C-CAN aims to expand West Coast wide (including British Columbia and Alaska), and be a model for the nation on science-based strategic planning for a threat in advance of major impacts. NOAA and the ocean observing systems are committed to helping compile and disseminate the information. And California's expert panel will work through how best to collaborate with, inform and benefit from C-CAN.

Working Session Conclusion: Group Discussion

In closing, the SAT generated a series of questions for the panel based on the presentations

throughout the day:

1. What are “natural” variations in acidification parameters, such as pH, in both space and time?
2. To what extent have, or are, we going to deviate from “natural?”
3. How much do land-based sources of nutrient inputs, such as runoff and wastewater discharge, contribute to local patterns of ocean acidification and hypoxia?
4. What biological responses have, or are likely to, occur in response to the present trends in acidification and hypoxia?
5. What research should be conducted to increase confidence in the answers to these questions?

- *Exploring Natural Variations; and Other R&D Constraints*

The panel will have to determine how best to scientifically determine what is “natural.” Some ideas included identifying historical data sets that might illuminate pre-anthropogenic conditions and influences. The SAT and speakers also listed some of the existing research and development constraints. For example, while instruments are under development, we do not have a great way to measure dissolved inorganic carbon or alkalinity fluxes. In addition, our ability to measure pH, as well as biological responses to changes in pH, are in their infancy. A core challenge will be supporting continued development of sensors, and training to use them.

- *Role of OPC-SAT with respect to the Panel*

Discussion on how the SAT should interact or guide the panel was preliminary. Initially it was agreed that the SAT should receive regular updates throughout the panel process, and participate in coordinating peer review. More broadly, discussion will continue around how the SAT can potentially use the work of the panel to develop research priorities and influence funding decisions for actionable science.

Part 3:
Business & Meeting Wrap Up

The meeting concluded with a few brief updates:

OPC-SAT Vacancies: There are currently two vacancies on the OPC-SAT. A member selection process will be initiated soon.

Scientific Collecting Permits: M. Carr provided a brief update on working with the Department of Fish and Game (DFG) to develop permitting for scientific collecting in MPAs. The working group is making great progress, and DFG is pleased.

New Upcoming Project: L. Whiteman gave the SAT a heads up that we will be engaging them on a new project to identify and articulate research priorities for MPA monitoring, including how the MPAs can inform other management arenas such as fisheries and climate change.

Central Coast Symposium: Finally, L. Whiteman informed everyone that the registration deadline is extended, and to sign up for the State of the Central Coast Symposium today at http://www.stateofthecacoast.org/.