Ocean Protection Council Science Advisory Team Workshop

The Science of Climate Adaption in California

10:00 AM - 5:00PM, Tuesday, May 23, 2017
Elihu M. Harris State Building, Room 1, Oakland, CA

Workshop Participants

OPC-SAT Executive Committee: S. Murray (Co-Chair Elect), F. Chavez (Co-Chair), T. Maloney (Co-Chair), K. Nielsen (Co-Chair Emeritus)

Other OPC-SAT Members: R. Ambrose, A. Boehm, M. Carr*[1], D. Cayan*, K. Coale, C. Costello, H. Doremus, J. Field*, B. Fraley*, S. Gaines*, G. Griggs, F. Gulland*, M. Hall-Arber, G. Hofmann*, S. Johnson, B. McCovey*, J. Paduan, J. Schubel*, J. Stachowicz, C. Striplen*, W. Sydeman, S. Weisberg

State Participants: J. Eckerle (Ocean Protection Council), J. Phillips (Ocean Protection Council), D. Aseltine-Neilson (California Department of Fish and Wildlife), B. Ota (California Department of Fish and Wildlife), J. Wall (California Natural Resources Agency), L. Bedsworth (Governor's Office of Planning and Research), J. Anderson (Department of Water Resources)

Additional Workshop Participants: B. Riordan (Climate Readiness Institute), S. Newkirk (The Nature Conservancy), N. Mantua (National Oceanic and Atmospheric Administration), T. Hill (University of California, Davis), R. Kudela (University of California, Santa Cruz)

Ocean Science Trust Staff: H. Carter, L. Kellner, M. Kent, E. Knight, E. Meyer, E. Ramanujam, L. Sievanen, S. Wheeler, E. Whiteman

OPC-SAT workshops are open to the public.

Workshop Summary

The Ocean Protection Council Science Advisory Team (OPC-SAT) has produced a substantial body of work over the past year, supporting the State's science needs on topics ranging from climate change and California fisheries, harmful algal blooms, marine protected areas, and sea-level rise. As California works towards the development of its 4th Climate Change Assessment, the OPC-SAT has a prime opportunity to weave together their existing work to inform how California responds to the changes ahead. This workshop was also an opportunity for the OPC-SAT to continue formalizing the procedures under which they operate, and explore their role and function as a scientific body that informs Ocean Protection Council (OPC) priorities in both the near- and longer-term.

At this workshop, Ocean Science Trust brought the OPC-SAT together with decision-makers to:

- **Scan the Horizon:** Inform OPC's strategic planning and priorities through a horizon scanning exercise, in which the OPC-SAT had a formal opportunity to identify current and emerging science issues and research that they perceive as important for California in the near- and long-term
- **Inform a Statewide Ocean and Coastal Climate Change Adaptation Report:** Discuss the formation of an OPC-SAT Working Group to develop a Statewide Ocean and Coastal Report as part of California's 4th Climate Assessment

1* Member unable to attend.

Part I - Horizon Scanning: Identifying Salient Ocean and Coastal Science in California

The OPC-SAT was asked to identify emerging ocean and coastal science issue areas that California should prioritize in both the near-term and longer-term to inform priorities within OPC's current program areas, as well as longer-term strategic planning. Ocean Science Trust presented results of a pre-workshop survey, in which OPC-SAT members were asked to contribute their top five emerging science questions or challenges, along with a rationale and potential opportunities for each. Contributions ranged from high level issue areas (e.g., climate change impacts), to specific questions (e.g., what are the food web impacts of ocean acidification?). Given the varying levels of specificity contributed in the survey, the discussion that followed focused on how to further refine a formal framework or process for horizon scanning and how the State envisions using the information gathered.

Next steps: *The OPC and Ocean Science Trust are working together to further define the function of a horizon scan and how the State intends to use the information gathered. These iterative conversations will help inform development of a more formal horizon scanning process so that the OPC-SAT can continue to bring forth emerging science relevant to California.*

Part II - California's 4th Climate Change Assessment: Developing a Statewide Ocean and Coastal "State of the Science" Report

As a component of California's ongoing 4th Climate Change Assessment process, the State has identified the need for regional reports for all areas of California, including the ocean and coast, to inform adaptation planning efforts across multiple sectors (e.g., food provisioning, shoreline change, water quality, etc.). The OPC asked Ocean Science Trust to convene a working group of the OPC-SAT to develop the Statewide Ocean and Coastal Report that:

- synthesizes knowledge of the impacts of climate change across ocean and coastal ecosystems and human communities;
- recommends science-based solutions to inform ecological and social resilience planning; and
- identifies priority knowledge gaps and science needs to advance the State's ongoing adaptation research agenda.

Workshop discussion focused on impacts and potential adaptation opportunities centered around four major themes: food provisioning, shoreline change, water quality, and coastal and marine ecosystem structure and function. Ideas discussed during the workshop will inform the scope of the report.

Next steps: *Ocean Science Trust has been participating in meetings with other regional report authors to more fully scope the audience and need, and will be working with the OPC-SAT Executive Committee and other partners to convene a working group to write the Statewide Oceans and Coastal Report as part of California's 4th Climate Assessment through 2018.*

Full Proceedings

1. Introduction and Opening Remarks

1A. Welcome Remarks

Tom Maloney, *Executive Director, Ocean Science Trust (formerly)*
Jenn Eckerle, *Deputy Director, Ocean Protection Council*

T. Maloney welcomed Ocean Protection Council Science Advisory Team (OPC-SAT) members, decision-makers, invited speakers and public members for attending the OPC-SAT spring 2017 workshop. J. Eckerle echoed T. Maloney's sentiments, and expressed her excitement to take part in her first OPC-SAT workshop. She thanked OPC-SAT members for their continued service to the State and looked forward to the day's conversation. T. Maloney acknowledged the breadth of work that the OPC-SAT has accomplished through working groups and advisory committees since their April 18, 2016 workshop "Bracing for A Changing World", including:

Fisheries

"*Readying California Fisheries for Climate Change*" (June 2017)

OPC-SAT members Francisco Chavez (Monterey Bay Aquarium Research Institute) and Christopher Costello (Bren School, University of California, Santa Barbara) served as co-chairs of the OPC-SAT working group convened from January 2016 through June 2017. The group was led by Ocean Science Trust staff Leila Sievanen, with support from Sarah Wheeler, and has now completed a report on their findings. The report provides guidance and management options for the California Department of Fish and Wildlife (CDFW) through four climate change scenarios and seven management strategies. The report is intended to inform the Marine Life Management Act (MLMA) Master Plan amendment through 2018.

- Download the full report (here) and companion summary (here).

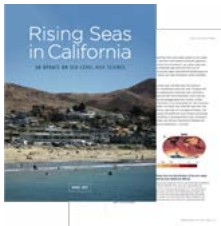
"*Scientific Peer Review: Guidance and Recommendations for the California Department of Fish and Wildlife*" (June 2017)

OPC, on behalf of CDFW, asked Ocean Science Trust to provide guidance to the State on peer review as an adaptable tool for ensuring rigorous science is integrated across California's fishery management continuum. Ocean Science Trust convened an Advisory Committee of the OPC-SAT to provide input throughout this project. Members included C. Costello, E.J. Dick (Southwest Fisheries Science Center), and Manoj Shivlani (Center for Independent Experts). The project was funded by OPC and the report intendeds to inform the MLMA Master Plan amendment through 2018.

- Download the full report (here).

Sea Level Rise

"*Rising Seas in California: An Update on Sea-Level Rise Science*" (April 2017)



OPC-SAT members Gary Griggs (University of California, Santa Cruz), and Daniel Cayan (Scripps Institution of Oceanography), served as co-chairs of the working group with support from Liz Whiteman, Ocean Science Trust. This effort was a collaboration between OPC, the California Natural Resources Agency, the Governor's Office of Planning and Research and Ocean Science Trust. The report reflects recent advances in ice loss science and projections of sea-level rise. Its findings are to be used to update the State of California Sea-Level Rise Guidance Document, which provides guidance to state agencies for incorporating sea-level rise projections into planning, permitting, investment and other decisions. Public engagement workshops took place in May - June 2017.

- Download the full report (here).

Harmful Algal Blooms

FAQ: Harmful Algal Blooms and California Fisheries (August 2016) and *Framing the Scientific Opportunities on Harmful Algal Blooms and California Fisheries: Scientific Insight, Recommendations and Guidance for California* (October 2016)
In response to the 2015/16 domoic acid events, OPC and the Interagency Marine Harmful Algal Bloom Task Force asked Ocean Science Trust to convene an OPC-SAT working group to provide scientific guidance on how to add capacity and support state needs. Working group members included Dave Caron (University of Southern California), William Cochlan (San Francisco State University), Raphael Kudela (University of California, Santa Cruz), and Gregg Langlois (California Department of Public Health (retired)).

- Ocean Science Trust produced a "Frequently Asked Questions" document (here) in response to questions submitted by fishermen and the California legislature.
- The working group produced a recommendation and options report (here) to bolster the State's existing monitoring programs.

Marine Protected Areas

A Framework for Informing Permitting Decisions on Scientific Activities in Marine Protected Areas (seeking publication)
To ensure that marine protected area (MPA) goals are met, managers must understand the likely ecological impacts of proposed scientific work in order to determine whether these activities should be permitted within MPA boundaries. This working group, led by OPC-SAT member Mark Carr (University of California, Santa Cruz), Emily Saarman (University of California, Santa Cruz), and Brian Owens (California Deapartment of Fish and Wildlife), presents a quantitative, ecologically-based decision tool to help managers consistently and objectively estimate the cumulative ecological impacts of proposed, ongoing, and recently completed scientific activities on macrobiota in MPAs.

- Download the full report (here).

1B. OPC-SAT Business

Tom Maloney, *Ocean Science Trust*

OPC-SAT Executive Committee Member Transitions

- Karina Nielsen (Romberg Tiburon Center for Environmental Studies, San Francisco State University) ended her term on the OPC-SAT Executive Committee and was presented an award by T. Maloney for her three years of service.
- F. Chavez is now co-chair emeritus and Steve Murray (California State University, Fullerton), now serves as co-chair. Jay Stachowicz (University of California, Davis), was elected by OPC-SAT members to serve as co-chair elect.
- In light of T. Maloney's departure from Ocean Science Trust, K. Nielsen has agreed to serve as Interim Science Advisor to the Ocean Protection Council.

OPC-SAT Member Transitions

John Field (NOAA Fisheries Southwest Fisheries Science Center) and Frances Gulland (The Marine Mammal Center) have formally stepped down from the OPC-SAT. Ocean Science Trust, working closely with the OPC, will be launching a public nomination process for appointing new members in the coming months. Details to come.

1C. OPC-SAT Working Procedures

***Steve Murray**, Executive Committee Co-Chair of the OPC-SAT, Interim Provost and Vice President for Academic Affairs and Professor of Biology Emeritus, California State University, Fullerton*
***Emily Knight**, Program Director, Ocean Science Trust*

In response to a need identified at the previous April 18, 2016 OPC-SAT workshop, the Executive Committee, Ocean Science Trust and the OPC have been developing several resources to articulate and formalize OPC-SAT working procedures. S. Murray presented an update and details of three draft documents that have been developed over the past year:

1. **OPC-SAT Working Procedures**: This is an outward facing document meant for a public audience that clarifies member responsibilities and work modes. The document includes details on the formation procedures, work scope, membership, work products, review process, and the procedures for Full OPC-SAT Endorsement. The document outlines the expectations of OPC-SAT members and defines the functions of the OPC-SAT as follows:

    - Identifying emerging environmental challenges and scientific issues.
    - Providing advice and translating scientific knowledge.
    - Evaluating the scientific and technical merit of proposals, projects, and documents.
    - Serving as a conduit to the broader scientific community.

The document also identifies four work modes of the OPC-SAT:

A. **Expert Taskforces**: This is the most common OPC-SAT work mode, and includes:
    - Working groups (e.g. Climate Change and Fisheries, Sea Level Rise)
    - Review teams (e.g. Abalone Density Methods Review)
    - Standing groups (e.g. OPC Strategic Plan Topical Areas)

B. **Advisory Committees** (e.g. Fisheries Peer Review Guidance)
C. **Expert Panels** (e.g. The West Coast Ocean Acidification and Hypoxia Panel)
D. **Individual OPC-SAT member engagement**

2. **Review and Endorsement of OPC-SAT Products**: An internal document that describes procedures for both internal and external review of an OPC-SAT work product. The draft also outlines and defines the meaning of "Full OPC-SAT Endorsement." For Full OPC-SAT Endorsement, the Taskforce product must meet the Standards of Quality (scientific accuracy, process integrity, and product consistency) for the OPC-SAT.

3. **OPC-SAT Appointment Procedures and Leadership Structure**: An internal document that codifies appointment and reappointment procedures and leadership structure, including the process for filling OPC-SAT vacancies, criteria for candidate and nomination procedures, and the selection process. The draft document also addresses member terms, term renewal, and expectations for renewal. Lastly, the draft document describes the OPC-SAT Executive Committee as the leadership body of the OPC-SAT and outlines eligibility for service on the committee.



The group discussion of the draft working procedures documents centered on:

- ***Endorsement procedures.*** The group discussed the need to further codify what Full OPC-SAT Endorsement signifies given that not all members will have strong topical expertise in every product produced via an OPC-SAT work mode. In particular, members grappled with whether consensus or unanimity should be required for Full OPC-SAT Endorsement. The group coalesced around the concepts that Full Endorsement means that the product has undergone robust review and that any significant dissenting viewpoints have been addressed.
- ***Membership terms and renewals.*** Members expressed their desire to have a more formal process for term renewals. This process would include outreach to members' whose terms are due to expire to determine their willingness to remain on the OPC-SAT. It was noted that participation by members of the OPC-SAT has been uneven and the group looked to the leadership of the Executive Committee to help determine whether a member's commitment and participation in OPC-SAT activities has been sufficient to merit term renewal. Some members may be better suited to different work modes, and this should be considered when evaluating the level of member participation. The group discussed ways in which to get new perspectives into the group including, for example, the appointment of more junior scientists to the OPC-SAT.
- ***Role of the Executive Committee in new member selection.*** The group discussed having the Executive Committee provide more input and to work more closely with OPC and Ocean Science Trust in the new member selection process.

Next steps*: The OPC-SAT working procedures will be made public following revisions based on discussion and suggestions from the workshop, as well as further review from OPC-SAT members, Ocean Science Trust and OPC staff.*

2. Horizon Scanning: Identifying Salient Ocean and Coastal Science in California

Request: Identify Emerging Ocean Science

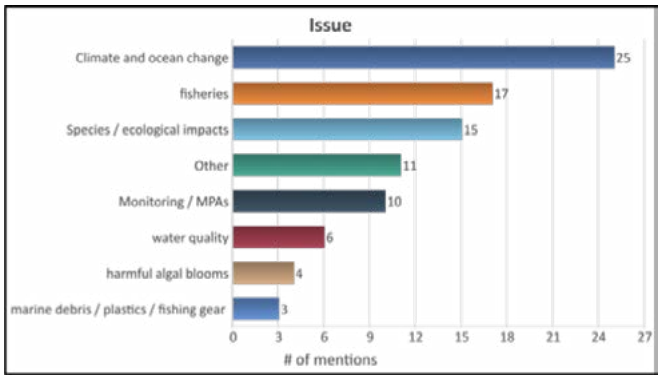
The OPC-SAT was asked to identify emerging ocean and coastal science issue areas that California should prioritize in both the near-term and longer-term to inform priorities within OPC's current program areas, as well as longer-term strategic planning. To inform the discussion and prior to the workshop, Ocean Science Trust conducted a survey that asked members to contribute their top five emerging science questions or challenges, along with a rationale and potential opportunities for each. Survey results formed the basis for this discussion and identified knowledge gaps and potential solutions.

2A. Overview and Presentation: Exploring California's Science Needs

Hayley Carter*, Program Scientist, Ocean Science Trust*

H. Carter presented survey results from 16 of 26 OPC-SAT members. Answers were coded and sorted into ***high-level issues*** (e.g., climate change), ***sub-issues*** (e.g., ocean acidification), and ***specific questions or focal areas*** (e.g., What are the effects of ocean acidification on coastal food webs?). The top high-level issues the OPC-SAT identified were:

- Climate and ocean change
- Fisheries
- Species/Ecological impacts
- Monitoring and MPAs
- Water quality
- Harmful algal blooms
- Marine debris/plastics/derelict fishing gear



H. Carter presented two case studies - ocean acidification and sea-level rise - to explore why California may seek to prioritize an issue. A prioritization may consider:

- Level of scientific understanding of the issue and its impacts
- Potential risk to California
- Timeline for onset of impacts
- Regional vs. a global issue

Specific focal areas identified by OPC-SAT members on the sub-issue *ocean acidification* included:

- Advancing field and lab studies to ID tipping points
- Identifying water quality thresholds
- Understanding food web effects for fisheries management
- Advancing physiological studies
- Understanding local drivers (e.g., terrestrial nutrients)
- Helping the aquaculture industry adapt to change

Current opportunities identified by OPC-SAT members on the sub-issue *sea-level rise* included:

- Begin planning and responding (e.g., beach nourishment, managed retreat, and coastal armoring)
- Explore coastal armoring designs that minimize ecological impacts
- Complete statewide modeling of coastal flooding, shoreline change from sea-level rise/storms
- Comprehensive and consistent data on offshore sediment resources
- Explore wetland migration options, tidal wetland restoration
- ID priority infrastructure and natural features to protect

2B. Discussion: Prioritizing and Aligning with State Needs

***Jenn Eckerle**, Ocean Protection Council*

J. Eckerle presented results from an initial survey of science needs from the California State Lands Commission (CSLC), CDFW, and the Fish and Game Commission to begin a conversation about how to explore overlap between the OPC-SAT contributions.

Emerging state priorities from an initial survey of state agencies with jurisdiction over marine and coastal resources included:

- Aquaculture
  - Impacts on eelgrass beds
  - Impacts to ocean ecosystems from finfish facilities offshore
  - BMPs that would reduce impacts (esp. marine debris)
- Artificial reefs
- Kelp restoration
- Offshore renewables
- Sediment management
- Fisheries
  - Fishing community resilience
  - Bycatch analysis
- Oil/natural seeps

Exploring the function and structure of a "Horizon Scan"

Substantial group discussion focused on what the function and role of a horizon scan should be given that the high-level issue areas gathered from the survey were not particularly novel, and OPC-SAT members approached the survey in different ways. In particular:

- *Should it be demand-driven with the State coming to the OPC-SAT asking for help, or supply-driven with the OPC-SAT suggesting areas of focus that are not currently on the State's agenda?*

The group agreed that both could be valuable, but understanding its utility, the venue to present findings, and the audience would be useful to better inform how OPC-SAT members and the State contribute. State representatives expressed the desire for science to be out ahead of policy, given that science is what agencies stand on when they propose regulatory changes.

Aligning with State Needs

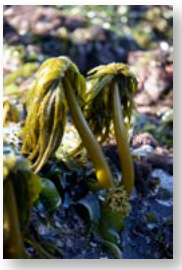
Representatives of CDFW and CSLC voiced a need for increased collaboration with the OPC-SAT, as many of the issues they work on require additional science capacity and thinking. Given that the OPC-SAT works on behalf of OPC science needs, and to coordinate overlap in requests for expertise among agencies, the OPC proposed serving as a conduit between State agencies and the OPC-SAT to engage on issues strategically. Some opportunities proposed included:

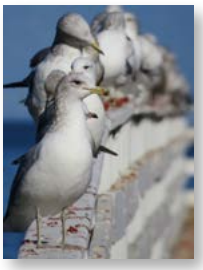
- Explore and connect the OPC-SAT to an existing research priority process. For example, a team of scientists

convened under the California Environmental Protection Agency developed the State's climate research plan in 2015. One idea might be to connect the OPC-SAT to that process, potentially informing funding decisions of projects. An update to that plan occurs every 5 years.

- Create an OPC-SAT advisory committee to oversee the horizon scanning function.
- Build a standing agenda item at the fall OPC-SAT workshop and invite State agencies to present a "here is where we are," "here is what's coming," and "here are some anticipated science needs."

***Next steps**: The OPC and Ocean Science Trust are working together to further define the function of a horizon scan and how the State intends to use the information gathered. These iterative conversations will help inform development of a more formal horizon scanning process so that the OPC-SAT can continue to bring forth emerging science relevant to California. K. Nielsen, as interim Science Advisor to the OPC, will present the findings at an upcoming OPC public meeting.*





3. California's 4th Climate Assessment: Developing a Statewide Ocean and Coastal "State of the Science" Report

Request: Statewide Ocean and Coastal Climate Change Adaptation Report

As a component of California's ongoing 4th Climate Assessment process, the State has identified the need for regional reports for all areas of the State, including the ocean and coast. Thus the OPC is asking Ocean Science Trust to convene a working group of the OPC-SAT to develop a Statewide Ocean and Coastal Report that:

- synthesizes knowledge of the impacts of climate change across ocean and coastal ecosystems and human communities;
- recommends science-based solutions to inform ecological and social resilience planning; and
- identifies priority knowledge gaps and science needs to advance the State's ongoing adaptation research agenda.

3A. Introduction: Helping the State Prepare for Climate Change

***Karina Nielsen**, Executive Committee Co-Chair Emeritus of the OPC-SAT, Director, Romberg Tiburon Center for Environmental Studies & Professor of Biology, San Francisco State University*

Goals for the afternoon included:

- Deepening the OPC-SAT's understanding of climate adaptation planning.
- Identifying an initial array of concepts to inform an Ocean and Coastal Report.
- Brainstorming the formation of an OPC-SAT Working Group to write the report.[1]

To set the stage, K. Nielsen introduced the chairs of existing OPC-SAT Working Groups, California 4th Climate Assessment Principal Investigators, and National Climate Assessment authors and asked that they describe recent projects and how the proposed Ocean and Coastal Report can advance the use of science in adaptation planning. Updates were provided in several topical areas as follows:

[1] This agenda item not covered during the workshop

Climate change and California marine fisheries

***Francisco Chavez and Chris Costello**, co-chairs of the Climate Change and Fisheries Working Group of the OPC-SAT*

The Climate Change and Fisheries working group assessed existing marine fisheries management practices to identify how the State is currently equipped to handle variability in climate, explore how management may be more dynamic in the face of future challenges, and what can be done to advance fisheries resiliency.

Harmful algal blooms

***Raphael Kudela**, University of California, Santa Cruz, external member of the Harmful Algal Bloom Working Group of the OPC-SAT*

Increasing HAB events are consistent with climate change, in both ocean, freshwater, and estuarine environments. In addition, synergistic effects of ocean acidification, desalination plants, among others, are poorly understood. The work of adaptation planning must understand these issues more holistically.

Engaging with the National Climate Assessment

***Nate Mantua**, co-author of the National Climate Assessment and member of the OPC-SAT Climate Change and Fisheries Working Group*

The National Climate Assessment will be in its fourth iteration and will incorporate fisheries, ecosystems, and the coastal effects of sea level rise, among other threats. NOAA Fisheries has launched an effort for a national strategy to address climate change.

Ocean Acidification and Hypoxia

***Karina Nielsen and Jay Stachowicz**, co-chairs of the OPC-SAT Aquatic Vegetation Working Group*

Building off the recommendations of the West Coast Ocean Acidification and Hypoxia Science Panel, this working group is exploring aquatic vegetation (specifically seagrasses and kelps) as an ocean acidification amelioration tool in California. The working group is developing a shared understanding of the state of the science and recommendations on next steps for California. A briefing document will be available in fall 2017.

***Tessa Hill**, University of California, Davis, Bodega Marine Lab*

Researchers at UC Davis are investigating the California mussel as an indicator species of ocean acidification and hypoxia stress using juveniles collected inside and outside of MPAs. Given that these species are easy to monitor, they can be used as metrics for physical and biological impacts in the face of climate change.

***Alexandria Boehm (former Chair) and Steve Weisberg (former Panelist)**: The West Coast Ocean Acidification and Hypoxia Science Panel, members of the OPC-SAT*

The West Coast Ocean Acidification and Hypoxia Science Panel's 2016 report "Key Findings, Recommendations, and Actions" has been well received and could prove to be a model for the Ocean and Coastal Report of the 4th Climate Assessment. Because the Panel proposed practical and actionable items, four of the eight recommendations have been implemented already, evidenced by the work mentioned today.

Sea-level rise and shoreline change

***Sarah Newkirk**, The Nature Conservancy, Principal Investigator for the California 4th Climate Assessment Shoreline Change Project*

Data show that seawalls have negative impacts both environmentally and economically. This project is exploring ways to integrate non-seawall alternatives (e.g., living shorelines) into adaptation planning.

***Bruce Riordan**, Climate Readiness Institute, Principal Investigator for the California 4th Climate Assessment External Project*

The Climate Readiness Institute is involved in four projects for the 4th Climate Assessment; two projects on coastal resilience strategies and two projects on extremes, environmental justice, and urban heat islands.

***Gary Griggs**, University of California, Santa Cruz, chair of the Sea Level Rise Working Group of the OPC-SAT*

This effort is an update to the State's sea-level rise guidance and projections under specific scenarios. Sea-level rise may be the biggest challenge civilization faces, as 150 million people live within three feet of the high tide line.

3B. Setting the Stage: California's 4th Climate Assessment and Request

***Jenn Phillips**, Policy Advisor, Ocean Protection Council*

J. Phillips presented an overview of the 4th Climate Assessment process and the need and timing for a Statewide Ocean and Coastal Climate Change Adaptation Report. Adaptation planning is essentially a two-step process: (1) the science assesses impacts across all sectors and regions of the State (e.g., transportation, natural resources, etc.), and (2) the policy, based on this science, is then updated in a new Statewide Adaptation Plan. Behind this effort lies a deep process that involves:

- **State decision-makers**: a major interagency effort to both coalesce around key science needs and to write the adaptation plans
- **Local decision-makers**: coordination with local decision-makers is key, as the plan must be useful at multiple scales
- **Scientific community**: many scientists are engaged in doing the research projects that feed into the adaptation plan
- **The public**: the adaptation plan takes into account public input via public meetings and a formal public comment period

The current adaptation plan is called *Safeguarding California: 2017 Update*, and is currently up for public comment. The 4th Climate Assessment is now underway, with research projects funded by the State and external projects set to wrap up by the end of 2017. In past assessments, funded ocean and coast projects focused heavily on sea-level rise and impacts to infrastructure. Starting with the 4th Climate Assessment, the State has expanded the funded projects[2], including natural infrastructure and bioindicators of ecological stress.

Engaging the OPC-SAT

The OPC is calling on the OPC-SAT to strengthen the 4th Assessment and to continue to expand the State's understanding of climate change beyond sea-level rise. The OPC-SAT has an opportunity to incorporate and amplify the great work of current and previous Working Groups into the assessment. By providing a more holistic picture, this is an opportunity for the OPC-SAT to set the vision and agenda for the State by not only illuminating solutions related to specific impacts, but to take a multi-stressor approach with an eye toward informing multiple management jurisdictions.

[2] A list of the 4th Climate Assessment research portfolio can be found here: http://resources.ca.gov/wp-content/uploads/2017/01/Resources-Research-Portfolio.pdf

The new Statewide Ocean and Coastal Climate Change Adaptation Report should:

- synthesize the most cutting edge science by both incorporating the funded and external projects, along with OPC-SAT work;
- recommend science-based solutions to inform ecological and social resilience planning; and
- identify priority knowledge gaps and science needs to advance the State's ongoing adaptation research agenda.

3C. Discussion and Q&A: Adaptation Planning in California and the Role of Science

***Jenn Phillips**, Ocean Protection Council*
***Jamie Anderson**, Senior Engineer, California Department of Water Resources*
***Louise Bedsworth**, Deputy Director, Governor's Office of Planning and Research*

Panelists highlighted the utility of past climate assessments. At a statewide scale, the 1st Climate Assessment was instrumental in passing the California Global Warming Solutions Act of 2006, which led to California's monumental Carbon Cap and Trade program. At more local scales, regions like Marin County have used these assessments to inform local planning decisions.

In response to questions by the OPC-SAT on the structure and scope of the report, Panelists provided the following insight to focus the report scope:

- ***Focus primarily on state and local decision-makers***. The report should be written for California decision-makers at state, regional, and local levels, with an opportunity to communicate nationally and internationally.
- ***Push toward systems thinking, across the land-sea interface***. Scaling up to connect the watershed to the coast, linking environmental/social/economic systems, the Ocean and Coastal Report will link to terrestrial region reports to provide a cohesive/holistic assessment. The Ocean and Coastal Report and the regional reports will be completed by July 2018.
- ***Provide a concise and compelling roadmap, with a focus on actions***. The report should emphasize ways to reduce risk and increase resiliency rather than providing a list of impacts, problems, or challenges that the State will face. The report should identify next steps for where California needs to go, and clearly communicate solutions for state and local governments.
- ***Ensure coordination between other regional reports***. Coordination between regional reports informing the 4th Climate Assessment will help to reduce overlap, and will be an iterative process.

Key Definitions

Ecological resilience: The adaptive capacity of ecological systems to cope with and recover from the impacts of ocean acidification, reduced oxygen, warming and other stressors (Managing for Resilience to Address OAH, West Coast Ocean Acidification & Hypoxia Science Panel, 2016).

Community resilience: The capability to anticipate risk, limit impact, and bounce back rapidly through survival, adaptability, evolution, and growth in the face of turbulent change (Definitions of Community Resilience: An Analysis, Community & Regional Resilience Institute, 2013).

3D. Breakout Work Session: Scoping a Report Outline

***Emily Knight**, Ocean Science Trust*

To harness the opportunity to set the vision and agenda for the State, workshop participants were divided into four groups, each composed of an interdisciplinary mix of scientific experts and decision-makers, to discuss ***ecological*** and ***social resilience*** for each of four theme areas. The purpose of this exercise was to begin gathering knowledge and ideas on:

- impacts of climate change to species, ecosystems, and human communities;
- solutions to promote ecological and social resilience;
- priority science needs and gaps; and
- scope and/or areas of expertise for an OPC-SAT Working Group.

Public attendees were encouraged to participate in a fifth group to share feedback and input on all themes.

Summary of discussion by breakout group theme

1. **Food provisioning** (e.g., commercial and recreational fisheries, aquaculture)
    - Wild fisheries and aquaculture will both be impacted by climate change, probably in different ways.
    - There are both science and policy gaps. For example, aquaculture is a less viable option in California right now because of the policy environment, and there are science questions as to the suitability of aquaculture habitat.
    - Recommendations: promote diversification, more responsive management, and get fishing communities to participate.
    - How will California balance trade-offs between food provisioning and conservation, in light of climate change?

2. **Shoreline change** (e.g., coastal development, natural and built infrastructure, erosion)
    - As part of the process, we must understand and articulate the State's goals more clearly, or what we are working toward, and then use the report to provide a scientific basis for achieving these goals.
    - California does not have a homogeneous coast: solutions will be place-based.
    - Decisions made and implemented now are short-term, interim solutions (coastal armoring, living shorelines, nourish beaches).
    - Ultimate solution is managed retreat[3] of shoreline ecosystems and habitats.

3. **Coastal and marine ecosystem structure and function** (e.g., physical and biogenic coastal and marine habitats, associated species assemblages, MPAs)
    - Major challenges for marine ecosystems will be distribution shifts, primary productivity, and changes in habitat forming species (e.g., kelp).
    - These challenges will also affect the human communities that depend on the coast for their livelihoods and recreation, as these ecological and social systems are linked.
    - Science-based solutions could begin by thinking about and providing for shorter-term solutions, providing a bridge for maintenance of ecosystem structures (e.g., finer-scale regional predictive modeling).
    - How does California's network of MPAs help promote ecological and social resiliency? Ongoing monitoring efforts could help our understanding (e.g., short-term recovery from HAB events, OA amelioration).
    - Greater reliance on the social sciences will be needed to best address how to mitigate human impacts resulting from changes in coastal and marine ecosystem structure and function.

[3] **Managed retreat** is a management strategy designed to avoid hazards and prevent ecosystems from being squeezed between development and the advancing sea (IPCC 2007). The most common mechanisms for managed retreat are *setbacks* that require new development to be a minimum distance from the shore, *density restrictions* that limit development, and *rolling easement* policies that allow development on the condition that it be removed to enable wetlands to migrate landward (Titus, 1998).

4. **Water Quality** (e.g., pollution, co-occurring stressors)
    - Ocean acidification has the potential to restructure marine food webs by affecting primary production, triggering changes in both ecological and human systems.
    - Other water quality challenges include nutrient runoff from agriculture and wastewater treatment plants (leading to hypoxia and eutrophication zones), and increased demand for desalination plants.
    - Modeling (e.g., food-web models, biological responses to OA) may be helpful, but future impacts are difficult to predict, therefore difficult to plan for.
    - Adopting the West Coast Ocean Acidification and Hypoxia Science Panel Recommendations and Actions represent progress toward addressing these challenges.
    - The Panel's findings could also be a model for the Ocean and Coastal Report.

Public attendee discussion

In discussing all themes, public participants emphasized that approaches to impacts must be interdisciplinary (thinking across systems) and ideas must be "outside the box." One example mentioned is acknowledging that species distributions will change and shift. We need to know more about these shifts and potentially consider managed relocation[4] for some species. Another example mentioned was exploring market-based solutions by partnering with risk management experts and the insurance industry (much like federal flood insurance and California earthquake insurance). This group also emphasized solutions and adaptations be on a more useful timescale.

3F. Group Discussion and Wrap-Up

***Karina Nielsen**, Executive Committee Co-Chair Emeritus*

K. Nielsen began the discussion by posing a question to workshop participants:

- *Was an ecosystem services approach useful?*

Group discussion expressed the understanding that policy solutions must balance multiple objectives and perspectives. And, although an ecosystem services approach could provide insight into ecological and social resilience, climate change is ultimately an anthropogenic problem in need of high-level political solutions. Questions that arose among the group included:

- *What role does the OPC-SAT have in developing solutions that are not necessarily science based?*
- *How precise can the OPC-SAT be about the magnitude of impacts and the need for some of the more controversial solutions (e.g., managed retreat)?*

It was noted by the group that science that illuminates and engages the public in understanding the likely impacts can help political solutions gain traction. The Ocean and Coastal Report can be an opportunity to engage both decision-makers and the public to take action in response to climate change, including mitigation and adaptation.

***Next steps**: At the request of the State, Ocean Science Trust will scope and convene an OPC-SAT Working Group, composed of approximately 6 to 8 interdisciplinary members, to serve as authors of the Statewide Ocean and Coastal Report to be completed by the fall of 2018. Ideas discussed during the workshop will inform the scope of the report.*

[4] **Managed relocation** is defined as the movement of species, populations, or genotypes to places outside the areas of their historical distributions to maintain biological diversity or ecosystem functioning with changing climate (Schwartz et al., 2012).

4. Workshop Wrap-Up

***Tom Maloney**, Ocean Science Trust*

California is setting a strong precedent, both nationally and internationally, for addressing climate change through adaptation planning and mitigation strategies infromed by scientific evidence. As shown through the breadth of work accomplished to date and today's discussion, the OPC-SAT is committed to helping advance California's climate-related priorities.

--Adjourn--

Reference

Pachauri, R.K., and Reisinger, A. (Eds.)(2007). Contribution of working groups I, II, III to the fourth assessment report of the Intergovernmental Panel on Climate Change. IPCC Geneva, Switzerland.

Schwartz, M.W., Hellman, J.J., McLachlan, J.M., Sax, D.F., Borevitz, J.O., Brennan, J., ... Schneider, S.H. (2012). Managed relocation: integrating the scientific, regulatory, and ethical challenges. *BioScience 62*(8): 732-743.

Titus, J.G. (1998). Rising seas, coastal erosion, and the takings clause: how to save wetlands and beaches without hurting property owners. *Maryland Law Review 57*(4): 1279-1320.

Photo Credits

Cover: iStock, Page 2: K. Lund, Page 5: OST, S. Finstad, K. Kurtis, Page 7: iStock, Page 9: T. Freidenburg, J. Altstatt, C. King, Page 10: N. Bednarsek, J. Pederson, Page 13: J. Kirklin, Back: OST