

Ocean Protection Council Science Advisory Team Workshop

Readying California's Fisheries for Climate Change

Workshop Proceedings

February 25, 2015, 10:00AM – 5:00PM
Hosted by California Ocean Science Trust
Elihu M. Harris State Building, Room 2, Oakland, CA

Workshop Participants

OPC-SAT Executive Committee: K. Nielsen (Co-chair Elect), M. Carr (Co-chair), S. McAfee (Co-chair), A. Boehm (Co-chair Emeritus, not in attendance)

Other OPC-SAT Members: R. Ambrose, D. Cayan, F. Chavez, C. Costello, H. Doremus, G. Griggs, M. Hall-Arber, S. Johnson, B. McCovey, S. Murray, J. Paduan, J. Schubel, W. Sydeman, and S. Weisberg

State Participant: S. Mastrup (California Fish and Game Commission), C. Shuman (California Department of Fish and Wildlife), D. Aseltine-Neilson (California Department of Fish and Wildlife), and T. Barnes (California Department of Fish and Wildlife)

Ocean Science Trust Staff: H. Carter, E. Knight, M. O'Donnell, E. Ramanujam, and E. Whiteman

Workshop Panelists: R. Fujita (Environmental Defense Fund), Rebecca Martone (Center for Ocean Solutions), and Elliott Hazen (NOAA Southwest Fisheries Science Center)

OPC-SAT workshops are open to the public.

Workshop Summary

As the State's anointed conduit to the broader scientific community, the Ocean Protection Council Science Advisory Team (OPC-SAT) is the appropriate venue for the State to access external scientific expertise and support. At this workshop, Ocean Science Trust brought together the OPC-SAT, state managers and policymakers, and other experts to develop approaches to planning for the potential risks to our fisheries from climate change – a shared priority between the Ocean Protection Council (OPC), the Fish and Game Commission (Commission) and the California Department of Fish and Wildlife (CDFW). Below are the initial areas of agreement and outcomes that emerged, providing a sound starting point for efforts going forward.

Updating CDFW's Master Plan is an opportunity to expand partnerships between independent scientists and the State.

Emerging from the OPC-SAT September 2013 workshop, [Advancing Science in California Fisheries](#), was a commitment to expand partnerships between fishery decision-makers and independent scientists. CDFW is now preparing to update the Marine Life Management Act (MLMA) Master Plan, CDFW's guide for fisheries management, and is seeking scientific guidance on how best to approach fisheries and climate.

- **Outcome:** Ocean Science Trust should convene a working group including OPC-SAT members, additional experts, and the State to develop a fisheries and climate change chapter and appendix for the MLMA Master Plan update.

At its core, this conversation is about supporting resilient fisheries in a changing and uncertain future.

Understanding ways to bolster the resilience of our coastal communities demands building stronger linkages—not just across agencies, and academics, but also with stakeholders. Central to the conversation of climate change and fisheries

are the impacts to fishermen and fishing communities.

- **Outcome:** The working group should elevate socioeconomic and cultural heritage impacts on the same level as the ecology and biology of the fish by in part incorporating a balance of interdisciplinary expertise.

More broadly, this conversation is about California's ocean health.

Supporting resilient fisheries raises a host of considerations, including community, governance, economy, and biology, just to name a few. Which raises questions: What are we managing towards, and at what scale? What scientific tools are at our disposal to evaluate tradeoffs and develop informed priorities? All questions that we began to explore at the last OPC-SAT workshop, [Exploring Ocean Health as a Scientific Concept and Management Goal](#).

- **Outcome:** This working group should consider framing its contribution to the Master Plan as a way to more clearly highlight the science needed to achieve California's management goals, which is a key component to the OPC's mandate to advance a healthy ocean for California.

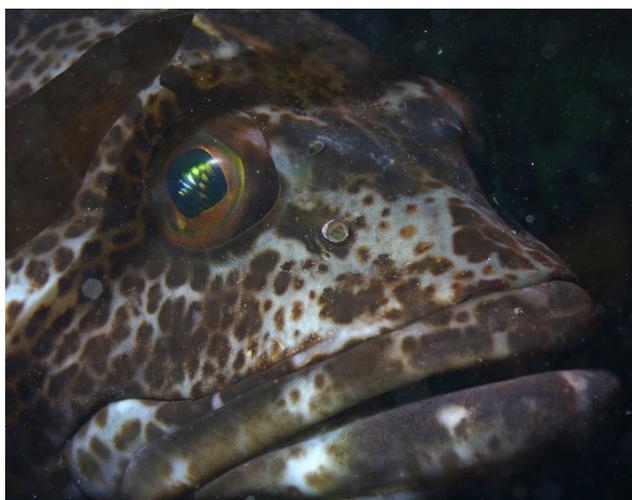
This working group aligns with other key efforts to address climate change already underway.

From sea level rise to ocean acidification, to using marine protected areas (MPAs) to understand the health of our coastal and ocean ecosystems, California is working with the OPC-SAT and others to harness scientific knowledge towards thoughtful adaptation strategies. For example, the [West Coast Ocean Acidification and Hypoxia Science Panel](#) (OAH Panel), which was seeded by the OPC-SAT and convened by Ocean Science Trust, is an illustration of the kinds of innovative, cross discipline approaches that are required to support management and policy in the face of a changing future.

- **Outcome:** This working group should be presented as another science-policy effort putting the information building blocks in place to help the State confront the complex impacts of climate change.

Next Steps

Going forward, many OPC-SAT members volunteered to be part of a working group convened by Ocean Science Trust to collaborate with the State to develop a chapter and appendix for the updated MLMA Master Plan. In particular, OPC-SAT members highlighted additional perspectives they hoped to bring to the table, including traditional ecological knowledge, lessons learned from other regions, the robustness of management institutions, and land-sea interactions. Immediately following this workshop, Ocean Science Trust will scope next steps and work with the State to design the appropriate process.



1. Welcome and Introduction

Skyli McAfee, Executive Director, California Ocean Science Trust; Science Advisor, Ocean Protection Council

This is our second OPC-SAT workshop themed around fisheries. At the previous meeting [Advancing Science in California Fisheries](#) on September 4, 2013, we explored ways to broaden CDFW's access to independent scientific resources. Since then, a variety of projects have emerged, including:

- OPC-SAT Task Force on Scientific Collecting Permits in MPAs;
- [Scientific Review of Northern Red Abalone Density Estimates](#);
- [Rapid Assessments for Selected California Fisheries](#);
- [California Spiny Lobster Fishery Management Plan Scientific Review](#); and
- [Ecological Risk Assessments report](#)

Through this work, we are building science-policy collaborations to advance key priorities, and deepening the OPC-SAT's understanding of CDFW's science needs, all of which positions us to now begin thinking about the potential impacts of climate change California's fisheries—a shared priority for the OPC, the Commission, and CDFW.

Today we will build on the conversation from the previous meeting, and brainstorm mechanisms to provide external scientific guidance and support to CDFW. Joining us are our state partners: the OPC, CDFW, and the Commission. They will provide their unique perspectives and guide us in what is most useful for fisheries management.

Catherine Kuhlman, Deputy Secretary for Oceans and Coastal Policy, California Natural Resources Agency; Executive Director, California Ocean Protection Council

Climate change demands that we work across sectors in ways we haven't before. A priority of the OPC is to help facilitate the kinds of cross-jurisdictional collaborations across ocean and coastal agencies we must pursue. With respect to adapting fisheries management in the face of climate change, we have strong enabling legislation in the MLMA, which allows us to think creatively and build ecosystem approaches. I am calling upon the OPC-SAT to bring your expertise and capacity to CDFW on this issue. Already, the OPC-SAT is engaging on a number of climate issues, including providing the State with guidance on sea level rise, and your role in seeding the OAH Panel.

2. OPC-SAT Business and Updates

2A. OPC SAT Business

Skyli McAfee, Ocean Science Trust

Welcome New OPC-SAT Members

We have two new OPC-SAT members since the last time we met:

- Briannon Fraley, Self-Governance Director, Smith River Rancheria (unable to attend)
- Dr. Chuck Striplen, Associate Environmental Scientist, San Francisco Estuary Institute

New Executive Committee Member Election Results

We would like to welcome Francisco Chavez, Senior Scientists, Monterey Bay Aquarium Research Institute, to the OPC-SAT Executive Committee. With this new appointment, A. Boehm will end her term on the Executive Committee. We would like to thank her for her service to this group [presented plaque by S. McAfee].

OPC-SAT Policy on Subcommittees

To clarify our policy on what constitutes official subcommittees or working groups of the OPC-SAT:

- OPC funded or requested scientific reviews, where the OPC-SAT is consulted by Ocean Science Trust to identify a team of reviewers; and
- working groups or panels convened by Ocean Science Trust at the request of the OPC to provide scientific guidance

on state priorities.

In all cases, the OPC-SAT will play a role in identifying additional experts from among the scientific community to participate. And in most cases, OPC-SAT members will serve on these groups, and/or chair them. Some examples of OPC-SAT subcommittees/working groups/panels:

- The Science Advisory Committee for the northern red abalone scientific review. Members included M. Carr and K. Nielsen (chaired by M. Carr).
- The West Coast Ocean Acidification and Hypoxia Science Panel. Members include A. Boehm, G. Hofmann, and S. Weisberg (chaired by A. Boehm).

2B. OPC-SAT Related Updates

OPC-SAT Task Force on Scientific Collecting Permits in Marine Protected Areas (MPAs)

Mark Carr, UC Santa Cruz

The goal of this project was to develop an objective approach for evaluating scientific collecting permit applications within MPAs. Our goal was to produce a tool that would allow CDFW to estimate the ecological impacts of proposed scientific collecting activities, and evaluate whether those impacts are appropriate relative to the conservation goals of the MPA at hand. The tool has two modules:

1. An ecological impact module that evaluates proposed project impacts on target and non-target species, and the habitat.
2. An impact threshold module that establishes thresholds of acceptable impact for each component of the ecosystem based on individual MPA goals, objectives, and regulations.

We have been working on this since June 2012. We have completed the conceptual design of the overall approach, and are in beta testing mode for the ecological impact module. The impact threshold module is also in progress. We aim to produce a peer-reviewed manuscript, and provide CDFW with a final report and presentation in June 2015.

Scientific Review of Reference Point Thresholds in the California Spiny Lobster Fishery Management Plan

Hayley Carter, Project Scientist, Ocean Science Trust

Ocean Science Trust is leading the [California Spiny Lobster FMP scientific review](#) on behalf of CDFW, supported by funding from the OPC. This effort is similar to the abalone density estimate review we conducted for CDFW in 2013. Like abalone, we worked with CDFW to scope this review, and hone in on the scientific and technical elements of the FMP to ensure that management of the recreational and commercial lobster fisheries is grounded in rigorous science.

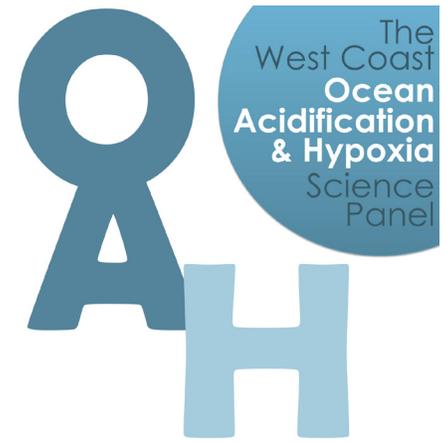
A key focus of this review is a spawning potential ratio (SPR) model that informs one of the 3 reference point thresholds that elicit when a management action may be warranted. This FMP also represents the first time CDFW has incorporated consideration of MPAs as a “credit” back to fishermen, as MPAs cover a certain percentage of lobster habitat.

We reached out to OPC-SAT members to provide recommendations for reviewers. Names of reviewers are anonymous until completion of the review, but the OPC-SAT continues to be engaged throughout with one member serving as review committee chair. We will continue to work with CDFW in the next several months, and aim to finalize the review in late spring. It has been great working with CDFW, continuing to build the relationships that were initially brokered via the abalone review. Scientific review is a valuable mechanism for forging new pathways to advance independent science in fisheries management.

2C. Advancing a Healthy Ocean for California: Update on the West Coast Ocean Acidification and Hypoxia Science Panel

Skyli McAfee, Ocean Science Trust

Convened in 2013, the [OAH Panel](#) is a multi-state, bi-national collaboration of 20 esteemed scientists from California, Oregon, Washington and British Columbia. Initially a California effort first called for by the OPC in September 2012, and launched following the November 2012 OPC-SAT meeting, [Ocean Acidification & Hypoxia: Engaging California in the Challenge](#), we are now poised to shape the conversation around these issues in ways that resonate nation-wide. Three members of the OPC-SAT serve on the OAH Panel, including Ali Boehm (chair), Steve Weisberg, and Gretchen Hoffman.



The Panel is producing a suite of products, including:

- a series of peer-reviewed publications addressing topical themes identified by decision-makers;
- translational ‘science-to-policy’ documents tailored to specific agency needs; and
- more visionary translational documents that lay out innovative ideas for how science can inform management now and in the future.

The most recent release was [Ocean Acidification and Hypoxia: Envisioning a Future Science Landscape](#), a translational product highlighting the need to step out of our respective disciplines and work together along the whole West Coast. The other products are in varying stages of completion (or the publication process), and will be released throughout 2015. The Panel will also produce an Executive Summary for Decision-makers at the end of its tenure in November 2015. This summary will sit on top of all the Panel’s work, and encapsulate the key messages and insights that are emerging from this effort.

One key message emerging from the Panel is the need to consider ocean acidification within the context of multiple stressors. The reality is, the primary drivers of ocean acidification are global, challenging management and policy to develop innovative solutions to brace for what is coming. This is a departure from the early focus of the Panel—which was more related to addressing the science needs of on-the-ground regulatory processes, such as 303(d) Assessments under the Clean Water Act. What the Panel learned over time is that we must also develop a vision for how science can better inform and bolster current management frameworks more geared toward ecosystem-based management goals, such as coastal zone management and MPAs, as opportunities to foster resilience in the face of multiple stressors. This links to what we are doing today: brainstorming approaches to harness science to strengthen fisheries management in the face of a changing and uncertain future.

We must remember how our various efforts, whether it is the OAH Panel or whatever emerges from our workshop today, do in fact knit together. At our last OPC-SAT workshop, [Exploring Ocean Health as a Scientific Concept and Management Goal](#), we identified the need to build a shared vision of ocean health, to help clarify what all these efforts are working toward: a healthy, resilient ocean for California.



3. Working Session: Ready California's Fisheries for Climate Change

Session leader: Karina Nielsen, Romberg Tiburon Center for Environmental Studies

3A. What Does a Changing Climate Mean for Fisheries Management in California?

Moderator: Karina Nielsen, Romberg Tiburon Center for Environmental Studies

Much of what we are doing now came out of our September 2013 workshop Advancing Science in California Fisheries. We have a variety of projects where we have partnered with the State that are either completed (abalone review) or underway (Scientific Collecting Permits). Since then, there have been a lot of great ideas about how to infuse science and provide scientific capacity to CDFW through new process and collaborations.

Every OPC-SAT member has something to offer these projects and working groups. This is about bringing our scientific thinking skills into the process, not just about particular aspects of our respective disciplines. The cross-disciplinary discussion is critical; the problems of climate change are multi-faceted and we need to consider economics, social science, and tribal perspectives, among others.

Today we will be hearing from decision makers about their priorities, sharing our perspectives, and beginning the discussion about tools and approaches to meet these needs. We will explore ways to approach this issue and brainstorm next steps. We have reached a major milestone where the OPC-SAT is becoming a valued partner.

Sonke Mastrup, Executive Director, Fish and Game Commission

The perspective I bring is that of a policy decision-maker. Craig Shuman will be speaking to you today on how to make those policy decisions real and actionable. Fisheries management is really the management of fishermen – not fish. During the last few decades, we dedicated time to managing to the biology and ecology of fish stocks. We've been successful, but climate change brings all that into question. We haven't spent as much time thinking about how fishermen and fishing communities will be impacted. Climate change threatens them too. We need to be thinking about the loss of infrastructure, the ability for fishing communities to adapt, and the training of the next generation of fishermen.

We need a more holistic approach that elevates socioeconomic and cultural heritage impacts on the same level as the ecology and biology of the fish. As the world's demand for protein increases, we need to ensure we approach these in a more thoughtful way. We need to be climate-ready both in terms of fish and fishermen. We have been pretty good at addressing the fish question, but not as good at addressing how fishermen and communities are impacted. We need to bring these two into alignment.

Craig Shuman, Marine Region Manager, California Department of Fish and Wildlife

Since the last meeting we have built stronger partnerships between CDFW and the OPC, the Commission, and Ocean Science Trust. Together we developed a Marine Region Strategic Work Plan. Some of the issues we plan to tackle (or are already underway) include:

- Investigate data streams, types of data collected, and electronic data collection
- Update MLMA Master Plan
- Fill existing management gaps
- Structural capacity and organization
- Funding

In the Marine Region, our scope has expanded from fisheries to resource management more broadly, including MPAs, aquaculture, climate change, and the land-sea interface. And yet, as our scope expands, our capacity is not expanding with it. Thus, through the Strategic Work Plan, we are beginning to set the framework for how we are going to prioritize and accomplish our goals. A key opportunity is creating additional access to resources and skill sets through stronger partnerships—with stakeholders, scientists, and others. Preparing our fisheries for climate change in particular demands this.

We have one person in charge of climate change for all of CDFW—that is Debbie Aseltine-Neilson. She will be a key player in any effort that emerges from today’s workshop. My challenge to the OPC-SAT is to explore how you can utilize your expertise to develop guidance on ways to assess biological and socioeconomic changes due to climate change on fish and fishing communities. Specifically, I would like to engage Ocean Science Trust in working with the OPC-SAT to develop a chapter and appendix on climate change and fisheries for an update to the MLMA Master Plan, CDFW’s guide for fisheries management.

Discussion Themes

Social Aspects of Fisheries

- Our understanding of the demography of fisheries and how they are changing over time is limited. We know some things, such as how restricted access has created a high cost for entry, making it hard for a young person enter a fishery, and perhaps shifting the fishery to an older demographic.
- The State has seen a change in the landscape of many fisheries from what it was 20 or 30 years ago, but again the knowledge is limited, making it difficult to elucidate management implications or terribly reliable in preparing for climate change.
- Fishermen in California do not have a lot of flexibility to switch between fisheries, or shift to something like aquaculture if their fishery were negatively impacted by climate change.

Management Structure & Priorities

- The State does work alongside the National Oceanic and Atmospheric Administration (NOAA) and the Pacific Fisheries Management Council (PFMC) when state and federal jurisdiction overlap. But often times there is more interaction on federally managed species, rather than State managed species. There may be opportunity to more formally engage them, or utilize their knowledge and/or data streams in support of State fisheries for considering both biological and socioeconomic impacts due to climate change.
- The State sees many opportunities for information to be fed into our management frameworks. If we can understand the types of changes that may occur, the range of impacts possible, or perhaps even monitor them in real time, we can build the flexibility we need into our management schemes to accommodate a more thoughtful response.
- Understanding and working towards guidance for incorporating climate change into management decisions is a priority. Often this is not necessarily reflected in day-to-day operations, not because it isn’t important, but because they do not have the right information or tools in hand to deal with it in an effective and efficient manner.

MLMA Master Plan Scientific Support

- CDFW would like Ocean Science Trust to work with the OPC-SAT to write a chapter and appendix for the MLMA Master Plan on climate change and fisheries. Whatever is produced must be usable. As such the OPC-SAT should think about simple guidance, and creative ways to provide options, such as:
 - Decision trees and flow charts. Identify options for management to keep information and data current and relevant. The more user-friendly this document is, the more valuable it will be for managers.
 - A review of the growing body of literature around socioeconomics, fisheries, and climate change could help CDFW wade through the current state of scientific understanding around this issue.
 - Identifying a catalogue of data would be helpful in understanding the range of potential changes we might expect, as well as determining the appropriate time frames for those changes.



3B. Perspectives from the Scientific Community

Moderator: Liz Whiteman, Ocean Science Trust

We have heard CDFW's request for the OPC-SAT to provide approaches and tools that slot directly into an update to the the Master Plan. Now we want to turn to developing ideas for how best to accomplish this task. We'll start with discussing the appropriate approach, then work through the details. Our first panel is comprised of OPC-SAT members expert in fisheries from different perspectives—biology, ecology, economics, and anthropology. The second panel is an array of experts experienced in developing vulnerability assessments. Throughout, I will be looking to our state partners to see how various ideas are landing.

Panel 1. Scientific Perspectives on Climate Risks to Fisheries

Panelists:

- **William Sydeman**, *President & Senior Scientist, Farallon Institute for Advanced Ecosystem Research*
- **Chris Costello**, *Professor, University of California, Santa Barbara*
- **Steve Gaines**, *Professor/Dean, Donald Bren School of Environmental Science, University of California, Santa Barbara*
- **Madeleine Hall-Arber**, *Professor, Massachusetts Institute of Technology*

1. ***From your scientific perspective, what does readying California's fisheries for a changing climate mean to you? How has your answer changed based on the information shared here today by state policymakers and managers?***

Panel Response

Bill Sydeman: I think we still have a lot we need to understand. Current predictive models need to be downscaled to a more local environment (i.e., state waters). They work by taking the information and applying it to the biology of species of interest, whether it is fish, birds, and/or humans. We're a long way from having these kinds of models.

We know the main drivers in this region are upwelling and the California current. What's going to happen to this ecosystem in the future? We know a lot about fish, but we need to know more about recruitment and movement patterns. This will be a big challenge, but it is important that we start thinking about different ways to do things. The more capacity the fisheries have to respond, the better the outcome.

Chris Costello: The biophysical perspective is really important, but I don't think we need to invest a lot of money in improving models. I think we could come up with a short list of possible consequences of climate change (range shifts, variability, etc.), then ask: how resilient are the current institutions—like fisheries management—to these sorts of shifts? Some are adaptive or robust to certain types of climate-related shifts, and others are not. We can then think about whether there are other institutions or frameworks that are needed to adapt. For example, we would expect cooperative quota shares to be robust to biological shifts due to climate change, but only for some species.

Madeleine Hall-Arber: We need better communication. We really need to get people out of their individual silos. Fishermen, processors, ice trucks, NGOs, managers, and scientists all need to be concerned. It is hard with our time limitations, but with greater communications skills, it's possible. We can take advantage of and work through existing institutions like harbor masters, fishing associations, and citizen science groups to name a few. There are a lot of established practices for communicating and getting information out. For example, look for specific individuals who are very knowledgeable about the local institutions and make sure they are brought in. All of this work needs to happen from the ground up.

Steve Gaines: I've done a lot of work on how marine communities are changing due to climate change. We know that right now, we're limited in resources and capacity to manage with the information we already have. Additionally,

we know we're operating in a very climate variable system (even without the effects of climate change). What are the institutions that will allow us to take into account the variability we know about? We don't necessarily need to start collecting a lot more data and developing approaches for forecasting. There are already a lot of 'data poor' methods, such as those based on size structure, that may be more robust to the shifts due to climate change than methodologies that require extensive stock assessment models.

2. *What are we really trying to do? Manage in the face of uncertainty, or minimize the uncertainty?*

State Response

Craig Shuman: We need to better understand the expected changes and associated uncertainty, and then build a portfolio of options in order to manage in the face of uncertainty. However, change in approach and management does not happen fast. If such shifts are needed, then we need to start thinking about this now.

Sonke Mastrup: The part about not having to get the predictive models pinned down before we can act really resonated with me. There is big diversity in fisheries and what the economics look like. And there definitely won't be one size fits all. We need a menu of options for different situations based on different biology, and socioeconomic conditions. However, trying to settle on an acceptable level of uncertainty will be a challenge.

3. *What are some of the unique opportunities or constraints (e.g., MPAs, ecosystems, socioeconomic) within California to consider in addressing climate change and fisheries?*

Panel Response

Chris Costello: We have a lot of opportunity in California. Our decision-makers are forward thinking. We have been proactive about pursuing ecosystem-based management. Relative to other parts of the world, our fisheries are sustainable. And finally, we have great scientists willing to donate their time. This is a great starting point. We can be a global leader here.

Steve Gaines: An important need is to better anticipate emerging fisheries. There will be shifts within the State due to our long coastline. California is poised to deal with such changes.

Madeleine Hall-Arber: California has a long history of people being engaged in the environment. There are a lot of institutions that care, community supported fisheries, adaptive marketing to take advantage of as you embark on this process. You also have great neighbors with whom to collaborate: Oregon, Washington. The tribal governments here are also vested in this issue and can provide a wealth of local knowledge to incorporate.

Group Discussion Themes

Uncertainty

- Scientists are generally comfortable with uncertainty, but beyond that it's a communication problem. Can we communicate: "if fishery does X we should do Y" as a way to link observation and response? Does that allow for more planning and more constructive dialog?
- In a way this is what harvest control rules are meant to do. I.e. "if biomass is X then we do Y," but the rules take into account many other factors such as location, temperature, etc.
- One challenge we face is communication to fishermen about uncertainty, because they need to proactively plan for their businesses.

Variability

- Timing and scale is a big issue when working in a system with a lot of inter-annual variability. The question needs to be how robust is your fisheries management to anything that changes over scales you weren't anticipating? We will likely need tools and approaches that respond to both short time scales to capture inter-annual variability, and also

very long time scale shifts like climate change. Building in options and response will be difficult though both in terms of management structures and in communicating with the community (NGOs, fishermen).

- Managers need options in the face of a changing future. They need institutions that provide flexibility. They need guidance and approaches as to when to let the variability “ride” and when to intervene to prevent undesirable outcomes.

Addressing Risk

- Risk can be many things. Risk of overfishing, risk of fisheries collapse, risk to food supply, risk to livelihoods- what do we mean when we use the word? Once we determine what types of risk we wish to address, we can look at strategies that perhaps reduce risk to all of them simultaneously. For example, we have looked at what MPAs have done for stock size, but not their capacity for providing protection or resilience in the face of a changing climate.
- From a fishermen’s perspective, loss of access to a species they target is a risk. Right now regulations limit and reduce their flexibility to move from fishery to fishery. Small-scale fishermen are usually impacted the most. And if a fishery moves to different grounds, this also poses a risk.
- We need to consider other aspects of the fishing community. With sea level rise, a real risk is access to working waterfronts. What will happen to the working waterfronts as storms increase in frequency and intensity? What if the fishing fleet has nowhere to go? Will we need new processing plants in different locations? These are all just examples of some of the food supply chain risks we should be considering. We need to keep in mind that there is a need to work with and communicate well beyond direct participants in the fishery.

Panel 2. Scientific Perspectives on Climate Risks to Fisheries

Panelists:

- *Errin Ramanujam, Associate Scientist, Ocean Science Trust*
- *Rod Fujita, Director of Research and Development, Oceans Program, Environmental Defense Fund*
- *Elliott Hazen, NOAA Fisheries*
- *Rebecca Martone, Ecosystem Health Program Lead, Center for Ocean Solutions*

- 1. *There has been much recent discussion of risk assessment frameworks and tools. What is the value and utility of a risk assessment approach when California fisheries management is faced with the implications of a changing climate?***

Panel Response

Errin Ramanujam: As we have heard several times today, we are faced with a changing future, but exactly how it will change is uncertain. Risk assessments are designed to operate within these scenarios of uncertainty. They have been deployed in many different arenas from climate change to earthquakes, to invasive species, and of course fisheries. So there is a lot for us to draw from. I also see risk assessments as an opportunity to launch a new dialogue and try something new together. These tools are one of the few things on the fisheries landscape that open those doors for new voices from across disciplines and activities. They provide opportunity for different types of data streams, including fisheries data, fisheries independent data, expert knowledge, and local and traditional knowledge. Through our work at Ocean Science Trust, I see them not just as a scientific tool, but also a mechanism for building partnerships.

Rod Fujita: I see our task as a need to develop a scientific basis for management to be more proactive, rather than just reactive. One way is to build predictive models that can provide you with a great deal of confidence, but are time intensive and costly. Another way is to put a bunch of experts in a room to assess risk, but there will likely be a lack of buy-in from stakeholders, and lack of confidence in results. Risk assessment frameworks lie somewhere between

these two examples. Instead of a fancy predictive model, you put people in a room (stakeholders, managers, experts) from a variety of disciplines and elicit knowledge from them in a disciplined way. Through this methodology, you can incorporate the data you do have, then fill in the gaps with expert elicitation and weigh your level of confidence in your judgments. The outcomes are results that are easy to understand, and draw on multiple types of knowledge.

Elliott Hazen: I have been working on the [NOAA Fish Stock Climate Vulnerability Assessment](#). It is very helpful in identifying the species most at risk and then targeting those species first. Through this tool, we can identify which fisheries we need to triage first, vs. which ones to take to the next level (e.g., Management Strategy Evaluation (MSE), or other methodologies).

Rebecca Martone: In my experience, risk assessments provide a way to build in transparency, integrate scientific advice, and assess environmental variability on ecosystem components, including people. They let you prioritize the things that matter to your management structures in a hierarchical way, including the risk of loss of ecosystem function. Or, if you apply a risk assessment consistently, you can start to evaluate tradeoffs between risk to stock and risk to waterfront communities. They let you then focus on the elements where management can have impact.

2. Risk assessments may be one way to operationalize some of the concepts and ideas we explored with the first panel. Is this the way we should be thinking?

State Response

Sonke Mastrup: Risk assessments are already utilized by many other federal and state agencies. I particularly like the ones that result in a suite of management options for each level of risk. Stakeholders know up front what information goes into the assessment, and the range of options based on different outcomes.

Craig Shuman: I like hearing that risk assessments are both participatory, transparent, and get us out of crisis management for dealing with climate change. I am looking forward to exploring more how we might operationalize risk assessment frameworks in California.

3. How can risk assessments be customized for CA, or customized to address climate change and fisheries? How do we look forward together?

Panel Response

Elliot Hazen: We have a push within NOAA right now, to do a nation-wide climate vulnerability assessment for fisheries. This could be a tool where the information gets adapted to regional scales.

Rebecca Martone: You don't need to reinvent the wheel. Risk assessments have all been building on and off of one another over time. Almost all are based on the idea of evaluating exposure, sensitivity, and adaptive capacity, whether you are evaluating climate change or fishing pressure, or species or the humans impacted.

Rod Fujita: Environmental Defense Fund has built two such tools that are both online. They look at the biophysical impacts as well as government structure. They help managers work through the risk assessment and then assess ways to modify governance to achieve your policy vision. They would have to be tailored to California, but could be one of the models you look to when thinking through your own.

Errin Ramanujam: California has a huge opportunity with risk assessments and other tools because of our MPA network. We are in a much better starting place because of this. Risk assessments, and other tools, can achieve a greater level of certainty and yield more valuable information with an MPA network in place.

Group Discussion Themes

How Managers Can Use Risk Assessments

- Environmental Defense Fund has worked with risk assessments in other countries for a variety of threats, including climate change. The information has been used by managers to make decisions from project siting to prioritizing

threats, both climate and non-climate related.

- Risk assessments can be used to prioritize which fisheries, ecosystems, or socioeconomic components you should focus your efforts on. The output may help managers select from a range of options and tools, or from a decision tree matrix.
- Many risk assessments can provide information both on which fisheries are at risk from climate change, and why they are at risk (e.g., susceptible to prey species being impacted, range shifts, or lack of data). Managers can use this information to further hone management actions for each risk category.
- There is also value to the process for generating risk assessments. They can garner stakeholder buy-in early on, especially if management options are laid out a priori to running the risk assessment.

Issues of Scale and Risk Assessments

- Risk assessments can be deployed to address any time scale. To consider climate change, we might want to consider projecting out 10 to 20 years, rather than just a snapshot of right now. The [NOAA Climate Vulnerability Assessment](#) is a good example of this.

Integrating Stakeholder Input into a Risk Assessment

- Stakeholder input has to be built into the process from the beginning, to build transparency into the process and gain the value of local expertise. They are critical to incorporating any kind of socioeconomic component. Stakeholders can also help define risk in any given situation, and shed light on particular species (and associate fisheries) of interest.
- California has a lot of mechanisms in place for bringing in stakeholder engagement, including advisory panels and stakeholder advisory groups, to name a few. Can use these as starting places for thinking through the most efficient and effective process for California.

3C. Concluding Discussion: Mapping Our Collective Path Forward

Moderator: Karina Nielsen, Romberg Tiburon Center for Environmental Studies, San Francisco State University

This session is the opportunity for us to develop next steps. We have heard a lot of perspectives that Ocean Science Trust and the OPC-SAT might consider in the course of developing a chapter and appendix for the MLMA Master Plan in collaboration with CDFW, OPC, and the Commission (and other partners), including:

- provide scientific advice on prioritizing fisheries at risk based on biology and/or management structure;
- further explore partnerships with others engaged in evaluating and managing fisheries in light of climate change, especially federal partners on the West Coast; and
- assess various tools available for managers beyond just risk assessments.

The idea emerged that Ocean Science Trust should convene a working group including OPC-SAT members, state decision-makers and other experts to advance this effort. Initially, OPC-SAT members who volunteered to participate in next steps are: Francisco Chavez, Chuck Striplen, Steve Gaines, Bill Sydeman, Madeleine Hall-Arbor, Steve Weisberg (if water quality expertise is needed), Holly Doremus (if policy expertise and flexibility in management systems expertise is needed), Chris Costello, and Karina Nielsen.

This is by no means a final list. In particular, OPC-SAT members highlighted additional perspectives they hoped to bring to the table, including traditional ecological knowledge, lessons learned from other regions, the robustness of management institutions, and land-sea interactions. Immediately following this workshop, Ocean Science Trust will scope next steps and work with the State to design the appropriate process.

4. OPC-SAT in 2015 and Beyond

Moderator: Skyli McAfee, Ocean Science Trust

Looking ahead, the OPC-SAT will continue to follow up on a range of dialogues beyond just fisheries, including ocean health. In particular, interest has been expressed in working with the State on climate change adaption, a likely topic for another OPC-SAT workshop in the near future.

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