

# SAB 2020-2021 Work Plan Discussion/ Potential New Working Group Topics: Synthesis

*From the July 10, 2019 Meeting*

The SAB has been working on the [2018-2019 work plan](#) and is nearing the end of it. It is time to start developing the 2020-2021 Science Advisory Board work plan. Some topics from the previous work plan might carry over to the 2020-21 plan. To that end, the SAB will proceed as before with a collaborative discussion among the SAB and with NOAA line offices and the working groups. NOAA is the beneficiary of these work plan focal areas, so it is important to get an understanding of what is most valuable to the agency. The following summarizes and synthesizes concepts and topics that emerged from the July 10 preliminary discussion. Notes of the full discussion are attached as an appendix.

## GENERAL TOPICS RAISED BY NOAA AND SAB

- **Enhancing Innovation:** The SAB could examine NOAA's approach to innovation by thinking of a more structured pathway to innovation. How can the SAB help NOAA look at what the future techniques, methodologies, etc. could be used to come up with the same answers to the same science questions, but with a more efficient way of doing this work? He noted that it's a major responsibility that NOAA has to steward and monitor greenhouse gasses in the atmosphere.

**SAB Commentary:** Some key questions include: What are agencies are doing in terms of innovation? What are the conflicts they are trying to resolve? What do we mean by innovation? What do we want to innovate? What does innovation mean within the context of NOAA? What are the kinds of things that, because NOAA is a federal agency, impede potentially what we mean by innovation? That is, what are the kinds of structural, organizational and legal boundaries that we need to observe that don't allow us to do something we now call innovation? Are we talking about being innovative or agile?

A challenge regarding innovation is resources. There are models NOAA could look at and try to emulate, but without people and money, it's hard to do. The NRL (Naval Research Lab) has a very large base with an investment in people as an example of a long-term commitment and long-term funding for innovation. ONR and NSF invest in people, but they invest in their program managers, not scientists in-house. The SAB could examine various models, but said it is largely all a matter of money and people and whether NOAA has the ability in terms of money, not the people part of it, but the money part of it, to actually fund. There are different models, and a growing body of experience, of different ways to stimulate innovation. The Board could provide NOAA advice for two possible streams of outcome: Number one is, in a low resource environment, how do we stimulate innovation; that is the reality NOAA is going to live with? Second, what should or could an agency with the scale of problems that we have in front of us -- weather, climate, oceans -- look like for an innovative environment?

There is rich literature on innovation with insights on encouraging multi-disciplinary participation, encouraging racial and gender diversity on projects, sponsoring maker spaces, business accelerators, pre-permitted zones, small grants to companies to allow them to try new approaches, and encouraging researchers with no prior experience to collaborate in areas that they've never worked in before. A challenge is how to integrate these in a low-cost manner to encourage innovation in the projects NOAA is working on.

- **NOS Relevant Issues:** NOS has not seen themselves in the previous work plan topics, such as Topic 3 on UxS (unmanned systems), which, as written, was very focused on extreme weather and water, and eDNAs—that the eDNA, which has many more applications than stock assessments. This may be a matter of expanding applications of the topics.

- **Social Sciences:** A number of suggestions were made with respect to social sciences research. These included a discussion of emerging technologies and social sciences, including big data, social media analytics, machine learning, artificial intelligence and similar approaches as applied to NOAA's social science research and applications. How might one weave emerging technologies into a social science topic or priority and consider how, for example, social media analytics can estimate or better estimate leaner real-time efforts for recreational fisheries or social media analytics for a better understanding of extreme event forecasting, etc. The main message is one of weaving the emerging technologies into the social science priority or topic.
  - How can NOAA better utilize emerging technologies to advance NOAA's social science research?
  - How can NOAA use emerging technologies to develop NOAA performance metrics?

*SAB Commentary:* NOAA has a hard time defining *what is a coastal science*, because there's ocean science, there's geophysical science, etc. What really makes it coastal is somehow combining that with the social sciences. *Can the Science Advisory Board help NOAA become more agile and harvest what's readily available on the table in some really important areas that will let us do our mission really across the board?*

The SAB is talking about the social sciences in two different ways, one more predominant than the other. In a lot of the discussions, the SAB has focused on a question of what elements are relevant to societal attitudes toward aquaculture, or to adaptation along coasts, and interventions. There is a second consideration that's increasingly examined as one thinks about the social dimensions of decision-making. This second consideration invites questions such as:

- What is the relevance of the decision processes and the decision structures themselves in terms of engagement of social sectors?
- And what is the relevance of co-development at the front end of any research on defining the problem set?
- Finally, what is the relevance of processes that allow for mutual learning as opposed to one-way transmission, 'here's our science; we're delivering it.'

These kinds of questions (co-development) as much as the former (social attitudes) are important because they bear on the relevance and meaningfulness of the research undertaken, the likelihood of uptake and use, the perceived credibility, and other things. These are two different clusters of research and consideration of social sciences.

- **Partnerships and Innovation:** For all of the topics, it may be useful to do a gap analysis of partnerships. How do we work with other agencies? How does NOAA work with other agencies and partners in terms of achieving the objectives? Partnerships are happening, but we're all looking within the context of the five-year strategic plan and the goals and objectives, which breeds myopia. Scientists are doing this work with very limited resources and piecemeal: are government agencies, and centers like NCAR, focused and looking at how to partner in a bigger way?

If we want more rapid transition of research to operations in general, we should not forget private-public partnerships. A lot of the slowness of the National Weather Service in going into operations is not because of risk aversion at the Weather Service, but the aversion of risk with downstream partners. Therefore, if we want to have this discussion about doing this faster, and being more agile, one must start on the end-user side. From the dissemination side, the issue is how NWS actually delivers all this information. How can one ensure that research transitions into something useful in the community?

## WORKING GROUP TOPICS

The most recent SAB work plan does not explicitly include a section on the work plans of these working groups. The EISWG and the ESMWG are referenced as contributing to select topics in the existing SAB work plan. The next work plan might include a brief description of the plans for each of the standing working groups—what their work plans are and how they fit together. The following sets forth Working Group proposals and activities.

1) **Environmental Information Services Working Group** proposes an assessment of NOAA’s progress toward meeting the *sub-seasonal and seasonal forecasting requirements*.

- The EISWG will complete an assessment of NOAA's progress toward meeting the sub-seasonal to seasonal (S2S) forecasting requirements set out in the Act. Some critical questions include:
  - Partnering with industry – how that is it going?
  - How are we looking at stakeholder requirements?
  - How are NOAA sub-seasonal and seasonal forecasts being used by these different stakeholders?
- EISWG and CWG efforts work in parallel and complement each other. The topic would allow for the formation of a team to submit a project proposal to the SAB, outlining how the two working groups would approach it.

*SAB Commentary:* EISWG was sharply focused on how well NOAA is meeting the Weather Act requirements for 2017. It is timely and is less of an assessment about NOAA plans and more about NOAA performance. The topic is well aligned with the CWG and complementary.

2) **Climate Working Group** proposes a focus on **S2S2D pathways to improved predictions**: The Climate Working Group plans to develop a white paper, *S2S2S-A Pathway to Improved Predictions*, that will review current capabilities and future opportunities for sub-seasonal to seasonal to decadal (S2S2D) forecasting, with a focus on research-based priorities in the S2S2D forecasting to understand and predict changes in earth's environment, with recommendations from the two-year, five-year and long-term perspectives. In the area of predictive power, there has been explosive growth in observational capabilities and in modeling capabilities and interest in adding biogeochemical data in support of things like ocean acidification, deoxygenation and ocean health issues that can be predicted as part of our ocean atmosphere system, can add to predictive capabilities, etc. With S2S2D and FV3 (the climate model core to the weather service operational models) becoming operational, a climate model is already integrated with an ocean, or stratosphere. What the CWG is interested in is the need for predictions of algae blooms, and not something delivered by a weather model but instead coming from an earth model. There is also a need to take advantage of available technology and a new world of having basically a climate model being used for weather, with all the potential of sea ice prediction in the Arctic. There are four particular opportunities that include: hybrid dynamic-statistical models; boundary layer processes; expanded ocean observations; and the use of bio-geochemical profiles. *The CWG already has a draft and an outline of a white paper; they are coordinating with EISWG and looking forward to being able to deliver the paper to the SAB.*

*SAB Commentary:* Related to the S2SD2 topic, there are some good prototypes to consider such as within the MOA with NCAR, like working on the joint infrastructure and prototypes such as MOM6, FV3, sea ice, Wave Watch and some chemistry up and running. Scientists were able to get these on the NSF computers running in two days. We need more eyes on the coupled modeling in general. There are struggles regarding whole system models for climate and making sure everything is included, including decadal, algae bloom, etc. We need to know something about the feedback mechanisms in the natural and physical world, as well as the predictions, which is how people, cultures, and entire communities will respond to certain incentives that come from understanding what the climate models will be telling us.

### 3) Ecosystem Sciences Management Working Group proposed three topics.

- **Socio-Economic Dimensions of Integrated Ecosystem Assessments (IEAs).** IEAs within NOAA are evaluations and decision-making processes that consider all components of an ecosystem, including humans, to enable managers to balance tradeoffs and determine which actions are most likely to achieve desired goals. The recent symposium reporting on 10 years of IEAs at NOAA emphasized the need for improved considerations of socioeconomic (human) dimensions within IEAs, including emphasis on non-fisheries human dimensions. Among the data needs is information on human uses of marine and coastal resources, including those in National Marine Sanctuaries. Other important issues concern human dimensions of emerging and sometimes conflicting uses of marine and coastal resources, such as transportation, energy production and tourism. This proposed report will review IEAs conducted within NOAA and make recommendations considering whether and how the assessment of socio-economic dimensions might be improved and the potential advantages of doing so. In doing so, it will evaluate both information needs and the capacity to obtain this information with available resources. It will also consider how newly available “big data” sources might be leveraged to provide relevant information (e.g., on human use patterns). **The goal would be to review IEAs as they currently stand and make specific recommendations regarding how you could capture socioeconomic dimensions, again given the bandwidth of the NOAA programs right.** The report will give explicit attention to how improved coverage of socio-economic dimensions can improve the capacity of IEAs to support ecosystem-based management, the coastal blue economy, and sustainable uses of marine and coastal resources.
- **Practical Methods for Adaptive Risk Management & Decision-Making under Uncertainty:** Given NOAA’s mission to reduce uncertain harms from the impacts of extreme weather and water events (2018-19 SAB Work Plan), the ESMWG proposes to explore recent advances in incorporating uncertainty into adaptive ecosystem management and decision support. We propose to develop a brief report with recommendations for the line offices for incorporating uncertainty into decision support research. Recommendations are expected to take the form of descriptions of a set of practical methods in use, approaches to tailoring those methods to NOAA’s needs, and suggestions for “right-sizing” the resources devoted to uncertainty analysis to the size of proposed investments and the potential consequences of underestimating risk. The report would further assess the usefulness of some existing tools (including ones used by the private sector, academia, and other federal agencies) and evaluate their utility and potential transfer to NOAA. This initiative would synthesize approaches for decision support under *deep uncertainty* to evaluate and suggest practical tools that NOAA may wish to use or transfer to local decision makers. *Deep uncertainty* is characterized by an inability to make useful future projections of a system state, based on past data and understanding (e.g., historic storm frequency and intensity). Such uncertainty undercuts the ability to cost-effectively manage risk, and decision support tools are being developed (and adopted by the private sector) to guide choices that are robust and responsive to unpredictable system dynamics. Emerging methods of understanding risk expand upon traditional risk assessment to examine a range of possible futures, be responsive to new information and assess the degree to which management options achieve their goals under diverse scenarios. The proposed work is potentially relevant to many types of scientific inquiry and modeling that support NOAA’s activities, including fisheries management, coastal resilience planning, offshore and shipping activities, and support for the blue economy. These methods can also be used to reveal data gaps and establish research priorities. This topic has broad support from the NOAA line office representatives who have reviewed and commented on this proposal (NOS, NMFS, OAR), with specific ways such information would be useful, including:
  - Assisting coastal (small) communities in assessing and managing erosion and storm surge risk by evaluating the conditions under which plans fail to generate net benefits
  - Developing and prioritizing vision areas for the R&D plan

- Balancing fisheries catch limits with ecosystem conditions that support the blue economy (recreation, jobs) under changing weather
  - Advancing the current use of risk tolerance in fisheries portfolio management
  - Providing recommendations for how to potentially improve stock assessments, IEAs, Section 7 consultations, etc., to accommodate deep uncertainties.
  - Improving communication of uncertainty in all types of ecosystem management
- **Aquaculture and Ecosystems in the 21<sup>st</sup> Century:** Recent NOAA efforts to promote US aquaculture will have consequences for marine and coastal ecosystems. These interactions affect the sustainability of aquaculture expansion, as well as the extent to which aquaculture can successfully co-exist with other uses of marine and coastal resources. Moreover, the extent to which the public supports aquaculture development in the US often depends on perceptions (and sometimes misperceptions) of ecosystem interactions. This report will consider US aquaculture expansion from a broader ecosystem context and advise NOAA on how an ecosystem perspective can help the agency promote more sustainable, productive and beneficial aquaculture nationwide. If this topic is supported by the SAB, we will invite NOAA’s Office of Aquaculture and Sea Grant that have been working with farmers and communities on existing and proposed aquaculture projects from different parts of the country. The proposed report is directly relevant to NOAA’s Ecosystem Approach to Aquaculture (EAA) and will build upon this prior effort. It will speak to both legal requirements that demand environmental stewardship and the science that allows aquaculture to meet those requirements. To provide context, we will review the scope of a limited number of projects and their potential impacts on coastal ecosystems, planned mitigation of those impacts, and “lessons learned” from similar projects in the United States and elsewhere. We will also review current management oversight and environmental impact review. Our report will pay particular attention to changing coastal ecosystems and the impacts of both current and future aquaculture practices, along with potential mitigation of those impacts.

***SAB & NOAA Commentary on ESMWG proposals:***

- Is there a possibility of integrating ideas from the first topic into the other two? There are social science dimensions in all three.
- Is there value-adding of IEAs? IEAs have evolved and become part of the science that goes into Ecosystem Based Management or Ecosystem Based Fisheries Management. What NOAA is now developing is management strategy evaluations. On the socioeconomic dimension, the management strategy evaluations begin with the objectives of the different social sectors, whether they're fisheries sectors or energy sectors or quality of life sectors and so on. *What are the social requirements for management of the ecosystem or management of the environment?*
- There may be high value in the ESMWG proposal, *Practical Methods for Adaptive Risk Management & Decision-Making under Uncertainty*, because coastal adaptation is a great national challenge, so NOAA agency should be in the forefront of that topic. How could the SAB could support NOAA on this topic? Decision-making in ecosystem management, within a complicated ecosystem, is important. What impacts are occurring and why do we care? If the *Socio-Economic Dimensions of Integrated Ecosystem Assessments (IEAs)* topic would address this, it could be useful.
- Aquaculture is a very young industry, and the SAB might want to weigh in and help inform the public and Congress about misconceptions about the status of aquaculture. The communication and social sciences aspect of the SAB’s work on this topic might help promote how aquaculture is evaluated.

# Summary of SAB 2020-2021 Work Plan Discussion/Potential New Working Group Topics

*From the July 10, 2019 Meeting Discussion*

## Introduction

The discussion started with the Chair introducing the status of the current work plan. The SAB has been working on the 2018-2019 work plan and is nearing the end of it. It is time to start developing the 2020-2021 Science Advisory Board work plan. She said it is possible that some topics from the previous work plan might be carried over to the 2020-21 plan. To that end, the SAB will proceed as before with a collaborative discussion not only among the SAB but with NOAA line offices, with the working groups. NOAA is the beneficiary of these work plan focal areas so it is important to get an understanding of what is most valuable to the agency. A quick list of the topics and status, as grouped under two priorities, from the 2018-2019 work plan were:

### **PRIORITY 1: REDUCE THE IMPACTS OF EXTREME WEATHER AND WATER EVENTS.**

- Topic 1: Oversee Development and Implementation of the Environmental Information Services Working Group Work (list from WRFIA) (ongoing)
- Topic 2: Review the Use of Observing System Simulation Experiments (OSSEs) (completed)
- Topic 3: Enhance Strategic Investment and Use of Unmanned and Autonomous Systems (ongoing)
- Topic 4: Review Improving Data Collection, Management, Dissemination and Decision Support, and Leveraging New Approaches such as those encompassed in the domain of Artificial Intelligence (AI) and Data Science (anticipated completion at end of 2019)
- Topic 5: Social Sciences and Decision Support in NOAA (relevant both to Priorities 1 & 2) (on hold)

### **PRIORITY 2: INCREASE THE SUSTAINABLE ECONOMIC CONTRIBUTIONS OF OUR FISHERY AND OCEAN RESOURCES (BLUE ECONOMY)**

- Topic 6: Sustainable Marine Aquaculture (completed)
- Topic 7: Evaluating NOAA Coastal Sciences (pending NOAA decision; not pursued by the SAB)
- Topic 8: Coastal and Marine Transportation and Support Infrastructure (decision to stand down on this topic after discussion with relevant programs in NOS)
- Topic 9: New Technologies for Fisheries Stock Assessments (anticipated completion at the end of 2019)

The Chair asked OAR Assistant Administrator Craig McLean and NMFS Chief Scientist Cisco Werner if they had initial observations to share. The SAB then heard short presentations by the working groups, followed by a lengthier open-ended discussion.

## Summary of the Chair's introduction to the subject:

- For the 2018-2019 work plan, the SAB had grouped efforts into the two areas that are priorities for the NOAA leadership. The first was to reduce the impacts of extreme weather and water events, and we had Topic 1: Oversee development and implementation of the Environmental Information Services Working Group, an ongoing endeavor.
- The review of the use of OSSEs – She reminded the SAB that Eugenia Kalnay led that effort, and that effort was essentially completed with a presentation at the spring SAB meeting. She said there may subsequently be follow-on topics, but that particular work topic, for what was defined, was completed.
- The third topic, "Enhancing strategic investment and use of unmanned and autonomous systems," was one where Bob Winokur recapped what is ongoing -- with some expected completion fall 2019. Mr. Winokur said the SAB would hear more about that on Day 2 of the July meeting, but, he said, basically the activity of the SAB budget brief on July 10 indicated that there is a line item in the budget for NOAA to expand its unmanned systems activity. He said Charly Alexander has been detailed to work for Admiral Gallaudet to pull together a strategic plan and, ultimately, an implementation plan. Mr. Winokur said the SAB role at this point will be to provide some advice as they work through what they're doing, and he is involved through the OMAO (NOAA Office of Marine and Aviation Operations) standing review board, serving in the same role. He said the topic work had kicked off an activity that now is becoming a much broader NOAA-wide activity in response to a couple of key drivers. One is the budget activity, which runs in 2020, somewhere between \$4 million and \$15 million, depending on Hill action, if the House number stands, and on the statutory requirement actually for NOAA through the CENOTE (Commercial Engagement Through Ocean Technology) Act that directs NOAA to produce excellent work with academia, industry and the Navy.
- Chair Scarlett said the work plans are very dynamic; some of them, like the OSSE, are bounded in time and that was what we anticipated doing. In other cases, like the unmanned and autonomous system, there is a huge issue, ongoing and long-standing. Part of purpose was to deepen and broaden the discussion.
- For Priority 1, Topic 4, "Review improving collection management dissemination and decision support using machine learning, artificial intelligence and data science," Bob Grossman and Chris Lenhardt are working on this and it's ongoing, with an expected completion end of 2020.
- Topic 5 is on hold. Originally, Richard Moss and the Chair had a keen interest in social sciences and decision support in NOAA, not as a stand-alone topic but as a more robust and wholly integrated construct. However, Richard has left the Board, and for a variety of reasons, the first proposition that had been proposed to carry this forward wasn't workable from the standpoint of cost. The Chair and Dr. Storksdieck have picked up this topic for further consideration.
- Priority 2 pertains to the blue economy "Increase in sustainable economic contributions of our fishery and ocean resources." The Chair said that Topic 6, "Sustainable marine aquiculture," is led by Dr. Rheault and ongoing with completion wrapping up. At the June telecom meeting, there was a presentation of the report. The SAB put it back on the agenda for July to have more discussion and additional slight refinements to the report before it's brought to conclusion.
- Topic 7, "Evaluating NOAA coastal sciences," was raised. The Chair said the SAB had some discussions, and there were other evaluations going on across this broad spectrum of science pertaining to coasts and NOAA's coastal responsibilities. She said there was a sense in some prior discussions that this either might be duplicative and/or it's so broad and big that it might exceed the abilities of the Board or the working groups to tackle. Therefore, there was no status/no answer, and the SAB left it to NOAA because it already was looking at the topic. Questions had been raised about: Is there duplication? Where is there complementarity? Are there gaps? The topic has been pivoted to NOAA rather than being led by the SAB.
- The Topic 8 coastal and marine transportation and support infrastructure was fundamentally completed. Dr. Reed gave a report in the spring.

- Topic 9 on emerging technologies for stock assessments is ongoing with a report to be completed by the end of 2019.
- Most of the work plan topic efforts will be completed by the end of this year. A few of them are ongoing, and one or two of them have been “parked” and can be reexamined as we look at the next work plan, the Chair said. She asked Craig McLean and Cisco Werner to provide comments before the working group presentations on their new topics.

### **Craig McLean:**

The first topic Mr. McLean raised was the “suppression of innovation” in NOAA. He noted that the Congressional oversight of science in the government has increased greatly in a way that prevents agencies from being innovative. He said the National Academy of Public Administration has done (or is doing) a study on how agencies incorporate science into their mission, and NOAA is noted as a good example of this. (Note: Innovation is discussed at more length toward the end of the work plan discussion in this summary.)

Mr. McLean posed the question, “How do we get past the suppression of innovation?” He had mentioned that “suppression,” in this context, is self-generated due to budget constraints and the partisan acrimony in Congress. He encouraged the SAB to approach innovation by thinking of a more structured pathway to innovation.

He also encouraged the SAB to help NOAA look at what the future techniques, methodologies and the like could be employed and used, in order to come up with the same answers to the same science questions, but with perhaps a more efficient way of doing this work. He noted that it's a major responsibility that NOAA has to steward and monitor greenhouse gasses in the atmosphere.

He noted that the SAB had been asked for views on the draft five-year research plan. He said it's very important that the Board be heard on how complete or what level of detail NOAA might be missing in our five-year research plan.

He said Fisheries and OAR agree that we would undertake this now; is the next step in our coupled earth system modeling. That's an area he thinks should stimulate some thought for the Board. Any help in guiding NOAA through that process would be appreciated. He commended the Board's vigilance in keeping an eye on NOAA to make sure the agency builds a system that has social science as part of the mainstream fabric of what the agency science programs are all about.

### **Cisco Werner:**

Dr. Werner said he wanted to focus on two sets of comments, one that came from the NOS position on the Research Council.

He said there is great interest in various topics, but they (Research Council) felt that some of the work in NOS was work where NOS didn't see themselves in the topics, at least as currently written, particularly Topic 5 on the social sciences.

Similarly with Topic 3 on UxS (unmanned systems), the feeling was that, as written, it was very focused on extreme weather and water, and again that there are some areas that perhaps could be broadened in terms of the impact of the UxS document. Maybe that's something that the strategic plan is working on and it might be a moot point right now.

He said the feeling was the same with eDNAs—that the eDNA has many more applications than stock

assessments. But this is a feeling that perhaps broadening the current consideration in the work plan on what statements are made on eDNA beyond what's currently there. This may be a matter of expanding applications of the topics.

He said a second comment that came from the Research Council had to do with the SAB's four standing working groups: *"The existing SAB work plan does not explicitly include a section on the work plans of these working groups. The EISWG and the ESMWG are referenced as contributing to select topics in the existing SAB work plan."* Dr. Werner acknowledged that he knows the two working groups are doing more than what was stated in the comment.

A summary statement could be that there might be an inclusion in the SAB work plan of brief descriptions of the plans for each of the standing working groups. He said that could clarify how the working groups function, what their work plans are, and perhaps how they fit together.

Dr. Werner went on to say that the Social Science Committee of the Research Council dealt with including a discussion of emerging technologies in the topic of social science, and they suggested an alternative way of writing Priorities 1 and 2. Dr. Werner said the statement is that emerging technologies refers to big data, social media analytics, machine learning, artificial intelligence and similar approaches as applied to NOAA's social science research and applications.

He said then two questions could be:

- How can NOAA better utilize emerging technologies to advance NOAA's social science research?
- How can NOAA use emerging technologies to develop NOAA performance metrics?

Dr. Werner concluded by saying this is similar to weaving emerging technologies into the social science topic or priority – then offering some examples of how, for example, social media analytics can estimate or better estimate leaner real time efforts for recreational fisheries or social media analytics for a better understanding of extreme event forecasting, etc. He said the main message is one of weaving the emerging technologies into the social science priority or topic.

## **Working Group Presentations (key points)**

### **Environmental Information Services Working Group**

Dr. Colman's comments summarized along with SAB input: The EISWG had met just prior to the July SAB meeting and discussed several topics the group had been visiting over the last year. They tried to determine the topic they group felt is timely and significant enough to elevate to the SAB as a work plan topic.

**Proposed: An assessment of NOAA's progress toward meeting the sub-seasonal and seasonal forecasting requirements.**

The EISWG decided to complete an assessment of NOAA's progress toward meeting the sub-seasonal to seasonal (S2S) forecasting requirements set out in the Act. The Weather Act is very specific. Title II of the Weather Act actually centers on S2S forecasting. It authorizes \$26 million per year for 'FY17 and '18 to address some of these other provisions of the Act.

Dr. Colman talked about a report David DeWitt and Fred Toepfer had presented, which provided a plan outline. The report is required by the Weather Act. It was due to be completed in October of 2018 and is very much needed. However, he noted the report would not be completed until Fall 2019, a year later than the original

requirement.

He added that the other takeaway from the DeWitt/Toepfer presentation and meeting was a breakout group from the EISWG. There were some critical questions to explore:

- Partnering with industry – how that is it going?
- How are we looking at stakeholder requirements?
- How are NOAA sub-seasonal and seasonal forecasts being used by these different stakeholders?

He concluded by noting that the Weather Act is a priority of NOAA's, and the connectivity between EISWG's work and the Climate Working Group. He said the EISWG and CWG efforts work in parallel and complement each other. He said the topic as presented for the SAB work plan would allow for the formation of a team to submit a project proposal to the SAB, outlining how the two working groups would approach it.

### **Climate Working Group**

Dr. Joellen Russell said the EISWG and CWG had coordinated and there is overlap. However, she said while the two groups think similarly and have a similar focus, they have different approaches.

### **Proposed: S2S2S-A pathway to Improved Predictions**

The plan for the Climate Working Group scope and focus and current efforts is to develop a white paper, *S2S2S-A Pathway to Improved Predictions*, that will review current capabilities and future opportunities for sub-seasonal to seasonal to decadal, S2S2D, the longer climate component forecasting, and this is pending. The CWG plans to collaborate with EISWG to review and help with their workload. (This has already been done successfully on the EISWG OSSE work.) The CWG main focus has been the new white paper. She noted the content as research-based priorities in the S2S2D forecasting to understand and predict changes in earth's environment, with recommendations from the two-year, five-year and long- term perspectives.

Dr. Russell noted the expertise within the Climate Working Group: oceanographers, prediction expertise, and meteorologists. She noted that in the area of predictive power there has been explosive growth in the observational capabilities and in the modeling capabilities. The CWG is excited to take a long look at what those outcomes might be, and then adding biogeochemical data in support of things like ocean acidification, deoxygenation and ocean health issues but that can be predicted as part of our ocean atmosphere system, that can also add to our predictive capabilities, and that the ocean, with its longer time scales, and some of the biogeochemistry may actually add to this capability.

Dr. Russell also noted that with S2S2D, and FV3 (the climate model core to the weather service operational models) becoming operational, a climate model is already integrated with an ocean, or stratosphere, an ecosystem (at GFDL in its research iteration.) What the CWG is interested in is the need for predictions of algae blooms, but not something delivered by a weather model but instead coming from an earth model.

She mentioned the opportunities and some current gaps with S2S2D, but there is also a need to take advantage of the technology that we have now that we've moved into this new world of having basically a climate model being used for weather, with all the potential of sea ice prediction in the Arctic. She divided the topic into four opportunities:

- hybrid dynamic-statistical models
- boundary layer processes
- expanded ocean observations
- the use of bio-geochemical profiles.

Dr. Russell said the four above were chosen because the CWG thought they were, as in the BGC (biogeochemical) Argo, exploding technology for both for prediction and verification of initial conditions. She noted the new ocean observing systems, including TPOS (Tropical Pacific Observing System) 2020, and the fact that the boundary layer schemes are going to have big issues, because this transition just occurred. The CWG thinks there are big opportunities in some of these things, and others are where the CWG thinks there are gaps. The four topics also relate to the expertise on the committee.

For S2S2D, and a longer time perspective, for these new capabilities in the earth systems (the ecosystems, the sea ice), we're doing on weather scales, both temporally and synoptically and in space, with adaptive grids, etc.

New papers are being written about this all the time. She mentioned upcoming sessions at the AGU (American Geophysical Union) this fall and then again at the Ocean Sciences meeting in the spring. The sessions will look at the opportunities, what are we doing now, what gaps are left, where are we going next and how the gaps can be resolved to get there. The CWG already has a draft and an outline of a white paper; they are coordinating with EISWG and looking forward to being able to deliver the paper to the SAB.

### **Ecosystem Sciences Management Working Group**

Co-chair Dr. Rob Johnston presented new topics from the ESMWG. The topics they proposed to the SAB follow with descriptions drafted by the working group members:

- **Socio-Economic Dimensions of Integrated Ecosystem Assessments (IEAs)**

IEAs within NOAA are evaluations and decision-making processes that consider all components of an ecosystem, including humans, to enable managers to balance tradeoffs and determine which actions are most likely to achieve desired goals. The recent symposium reporting on 10 years of IEAs at NOAA emphasized the need for improved considerations of socioeconomic (human) dimensions within IEAs, including emphasis on non-fisheries human dimensions. Among the data needs is information on human uses of marine and coastal resources, including those in National Marine Sanctuaries. Other important issues concern human dimensions of emerging and sometimes conflicting uses of marine and coastal resources, such as transportation, energy production and tourism. This proposed report will review IEAs conducted within NOAA and make recommendations considering whether and how the assessment of socio-economic dimensions might be improved and the potential advantages of doing so. In doing so, it will evaluate both information needs and the capacity to obtain this information with available resources. It will also consider how newly available “big data” sources might be leveraged to provide relevant information (e.g., on human use patterns).

The goal would be to review IEAs as they currently stand and make specific recommendations regarding how you could capture socioeconomic dimensions, again given the bandwidth of the NOAA programs right.

The proposed report relates directly to the Terms of Reference for the ESMWG and the SAB. It responds to the ESMWG’s mission to “provide scientific advice and broad direction to the NOAA Science Advisory Board (SAB) regarding NOAA’s ecosystem-related programs [and to] focus on the broad research, monitoring, and management components of NOAA’s ecosystem portfolio...” The report will give explicit attention to how improved coverage of socio-economic dimensions can improve the capacity of IEAs to support ecosystem-based management, the coastal blue economy, and sustainable uses of marine and coastal resources, all topics emphasized in the most recent SAB Work Plan.

- **Practical Methods for Adaptive Risk Management & Decision-Making under Uncertainty**

Given NOAA's mission to reduce uncertain harms from the impacts of extreme weather and water events (2018-19 SAB Work Plan), the ESMWG proposes to explore recent advances in incorporating uncertainty into adaptive ecosystem management and decision support. This initiative would synthesize approaches for decision support under *deep uncertainty* to evaluate and suggest practical tools that NOAA may wish to use or transfer to local decision makers.

*Deep uncertainty* is characterized by an inability to make useful future projections of a system state, based on past data and understanding (e.g., historic storm frequency and intensity). Such uncertainty undercuts the ability to cost-effectively manage risk, and decision support tools are being developed (and adopted by the private sector) to guide choices that are robust and responsive to unpredictable system dynamics. For example, the Bering Sea (AK) has experienced rapid rates of ocean warming and winter sea ice loss, which is transforming the marine ecosystem and affecting commercial fisheries, subsistence harvests, and threatened or endangered species. Because these changes occurred more quickly than predicted, managers had to re-assess management plans and strategies. Emerging methods to address challenges of this type expand upon traditional risk assessment to examine a range of possible futures, be responsive to new information and assess the degree to which management options achieve their goals under diverse scenarios. The proposed work is potentially relevant to many types of scientific inquiry and modeling that support NOAA's activities, including fisheries management, coastal resilience planning, offshore and shipping activities, and support for the blue economy. These methods can also be used to reveal data gaps and establish research priorities.

This topic has broad support from the NOAA line office representatives who have reviewed and commented on this proposal (NOS, NMFS, OAR). As part of this comment and review, they suggested several specific ideas of how such information would be useful

- Assisting coastal (small) communities in assessing and managing erosion and storm surge risk by evaluating the conditions under which plans fail to generate net benefits
- Developing and prioritizing vision areas for the R&D plan
- Balancing fisheries catch limits with ecosystem conditions that support the blue economy (recreation, jobs) under changing weather
- Advancing the current use of risk tolerance in fisheries portfolio management
- Providing recommendations for how to potentially improve stock assessments, IEAs, Section 7 consultations, etc., to accommodate deep uncertainties.
- Improving communication of uncertainty in all types of ecosystem management

We propose to develop a brief report with recommendations for the line offices for incorporating uncertainty into decision support research. Recommendations are expected to take the form of descriptions of a set of practical methods in use, approaches to tailoring those methods to NOAA's needs, and suggestions for "right-sizing" the resources devoted to uncertainty analysis to the size of proposed investments and the potential consequences of underestimating risk. The report would further assess the usefulness of some existing tools (including ones used by the private sector, academia, and other federal agencies) and evaluate their utility and potential transfer to NOAA. This effort would be led by ESMWG member Lisa Wainger, with assistance from other ESMWG members and in coordination with ESMWG contacts from multiple NOAA Line Offices (e.g., NMFS, NOS, OAR).

#### ○ **Aquaculture and Ecosystems in the 21<sup>st</sup> Century**

Recent NOAA efforts to promote US aquaculture will have consequences for marine and coastal ecosystems. These interactions affect the sustainability of aquaculture expansion, as well as the extent to which aquaculture can successfully co-exist with other uses of marine and coastal resources. Moreover, the extent to which the public supports aquaculture development in the US often depends on perceptions (and sometimes misperceptions) of ecosystem interactions. This report will consider US aquaculture expansion from a broader ecosystem context and advise NOAA on how an ecosystem perspective can help the agency promote more

sustainable, productive and beneficial aquaculture nationwide.

The measured and potential impacts of aquaculture activities centered in our bays and estuaries have led to a widespread mistrust of “farm-raised” finfish and other products, particularly on the West Coast. Over the past 20 years, there have been significant advances in feed production and delivery, disease and parasite management, net pen design, and multi-species culture systems that reduce waste impacts on native ecosystems. Offshore systems for fish and shellfish also hold potential for aquaculture that has lower environmental impacts. However, several concerns remain, including potential introduction of exotic species and parasites, the “footprint” of fish and shellfish farms in an increasingly crowded nearshore, and sea level rise.

If this topic is supported by the SAB, we will invite key personnel of NOAA’s Office of Aquaculture and Sea Grant that have been working with farmers and communities on existing and proposed aquaculture projects from different parts of the country. The proposed report is directly relevant to NOAA’s Ecosystem Approach to Aquaculture (EAA) and will build upon this prior effort. It will speak to both legal requirements that demand environmental stewardship and the science that allows aquaculture to meet those requirements. To provide context, we will review the scope of a limited number of projects and their potential impacts on coastal ecosystems, planned mitigation of those impacts, and “lessons learned” from similar projects in the United States and elsewhere. We will also review current management oversight and environmental impact review. Our report will pay particular attention to changing coastal ecosystems and the impacts of both current and future aquaculture practices, along with potential mitigation of those impacts.

### **Working Group Presentations Topics Discussion and Brainstorming: Key Points**

- **ESMWG proposals:** Dr. Donahue (as liaison to the ESMWG) asked if there is a possibility of integrating ideas from the first topic into the other two. Dr. Johnston said that there are social science dimensions in all three and this could be done. He also recognized later in the discussion that he is aware that there should be narrowing of the topics the ESMWG presented.

Dr. Reed questioned the value-added of IEAs, based on her past experience. She said there's an international group, professional group on decision-making under deep uncertainty, and there is a lot of thinking on this topic. She said it might be helpful in planting new ideas within the agency. Of the three ideas presented by the ESMWG, she was most receptive to *Practical Methods for Adaptive Risk Management & Decision-Making under Uncertainty* because she sees coastal adaptation as one of the great national challenges that we have, so NOAA agency should be in the forefront of that topic.

Dr. Polansky noted the importance of decision-making in ecosystem management, in a complicated ecosystem. He noted there is a question of how we manipulate the system and in what ways. He gave an example of fisheries management or thinking about the nutrients coming from the rivers. What impacts is that having and why do we care? How is that affecting the things that we care about, the fisheries, livelihoods and so forth. He said if the *Socio-Economic Dimensions of Integrated Ecosystem Assessments (IEAs)* topic would address this, he would be in favor of approaching this topic out of the three ESMWG topics presented.

Dr. Rheault addressed the aquaculture topic. He said it is a very young industry, and the SAB might want to weigh in and help inform the public and Congress about misconceptions about the status of aquaculture. He said the communication and social sciences aspect of the SAB’s work on this topic might help promote how aquaculture is evaluated.

- **Climate Working Group concept:** Related to the S2SD2 topic, Dr. Hendrik Tolman, NWS, said there are some good prototypes to consider such as within the MOA with NCAR, like working on the joint infrastructure and prototypes such as MOM6, FV3, sea ice, Wave Watch and some chemistry up and running. Scientists were able to get these on the NSF computers running in two days. Secondly, he said

one thing that really improves enormously with that is regarding sea ice. He was in favor of doing this and said we need more eyes on the coupled modeling in general. He added, “we just have to figure out if we do it in such a way that we really integrate these, and that we don't create a weather stovepipe and a decadal stovepipe.”

Dr. Storksdieck mentioned the struggle with getting great whole system models done for climate, and making sure everything is included, including decadal, algae bloom, etc. He mentioned the need to know something about the feedback mechanisms in the natural and physical world, as well as the predictions, which is how people, cultures, and entire communities will respond to certain incentives that come from understanding what the climate models will be telling us.

- **EISWG topic proposed:**

Dr. Colman said the EISWG was sharply focused on how well NOAA is meeting the Weather Act requirements for 2017. He said it's a very clear and high priority within the Weather Act itself, and the working group is looking at this. He said the Act has authorized funding attached to it and deliverables. Thus, it is timely and is less of an assessment about NOAA plans and more about NOAA performance. The group considered how much we have accomplished, specifically in these areas. He said their topic is well aligned with the CWG and complementary. Mr. McLean said it is very important for NOAA to have the EISWG view.

### **Other Topics Relating to the R&D Plan:**

- **Miscellaneous Topics:** Chair Scarlett mentioned the R&D plan comments the SAB had offered in this regard. The Chair said that as the R&D plan unfolds, there may be some additional opportunity to comment on the plan. Regarding the issue of geoengineering and related issues, one comment Chair Scarlett raised regarded the absence of any international protocols. What are the risk management and unintended consequences of issues, etc. What is going on in this regard? She also reiterated the issue of social sciences mainstreaming, and its importance, rather than treating that social sciences separately. She suggested that we've heard a lot about social sciences not being treated separately but that whatever work is done should consider and incorporate those dimensions.
- **Innovation and Suppression of Innovation:** From Dr. Decker and Chair Scarlett raised the issue of innovation and marketing science more effectively, including greenhouse gas observations, and techniques that would deliver information effectively and efficiently, including HPC, how to avoid lock-in, etc.

On innovation, Mr. Winokur said it takes money and people and that it's clear NOAA has the people, but it is not clear about money. But the agency does have a long-term commitment. He said there are models that NOAA could look at and try and emulate, but without people and money, it's hard to do. He added that management and the people on NOAA's staff are needed, along with the relationships with academia, industry, and the government.

He mentioned the NRL (Naval Research Lab) as having a very large base with an investment in people as an example of a long-term commitment and long-term funding for innovation. He said ONR and NSF clearly invest in people, but they invest in their program managers, not scientists in-house. Mr. Winokur said, “A lot of what you see today with respect to autonomous systems, that came out of ONR (Office of Naval Research) 20 years ago, they hired and had their staff, who had the foresight to say there's a future at ONR and there is a worthwhile investment in staff and academia because ONR doesn't do anything in-house.” He suggested that the SAB examine various models, but said it is largely all a matter of money and people and whether NOAA has the ability in terms of money, not the people part of it, but the money part of it, to actually fund.

Chair Scarlett said Mr. McLean's suggestion of a need might be recast somewhat, so that one is asking the question: *How does one get past suppression of innovation or have structured pathways to innovation in a resource constrained context?* She noted there are different models, and a growing body of experience of different ways to stimulate innovation. She noted that in the presentation by ESMWG Co-chair Castellini, there was an example of a situation in which huge resources expended in the medical arena have yielded technologies NOAA is now utilizing. In that case, NOAA itself is not the generator of that technological innovation but is striving to take advantage of that investment by the medical field. She made the point that one might recognize that NOAA's never going to be DARPA (Defense Advanced Research Projects Agency), but that points to reformulating the question: *Is there a way to enhance the prospects for innovation, for example, placing people in Silicon Valley?*

Drs. Grossman and Lenhardt both had comments related to working within a resource-constrained space and how the innovation of those like Elon Musk are nontraditional. A general comment pertained to the innovation and the permission to fail, and reasons to look at innovation even if the SAB does not have the capacity to solve some of the questions related to resource-based constraints.

Mr. McLean responded favorably to each of the suggestions made. He suggested couching this in two possible ways: The Board could provide NOAA advice for two possible streams of outcome: Number one is, in a low resource environment, how do we stimulate innovation; that is the reality NOAA is going to live with? Second, he said if the Board could do that and look at the notion of what should or could an agency with the scale of problems that we have in front of us -- weather, climate, oceans -- look like for an innovative environment? He said this is relevant whether or not that innovation is established in some other agency and NOAA can participate in it. He said, with the benefit of the experience of the SAB, and the reach that the Board has, maybe some inspiring objectives that could be set out, that could be helpful, as well as what we can do in a resource-constrained environment.

Dr. Rheault said as he was wrapping up his work on evaluating the science portfolio of aquaculture research, and Dr. Decker inquired about adding a piece on innovation; he found that there is rich literature on innovation. He said a few of the nuggets that he gleaned pertained to encouraging multi-disciplinary participation, encouraging racial and gender diversity on projects, sponsoring maker spaces, business accelerators, pre-permitted zones, small grants to companies to allow them to try new approaches, and encouraging researchers with no prior experience to collaborate in areas that they've never worked in before. He said the challenge is how to integrate these in a low-cost manner to encourage innovation in the projects NOAA is working on. He said the SAB making some recommendations in that vein might be productive.

Dr. Storksdieck posed a few questions regarding innovation:

- What are agencies are doing in terms of innovation?
- What are the conflicts they are trying to resolve?
- What do we mean by innovation? What do we want to innovate?

- Often, when we are in these agencies, we don't step back and ask what are the rules and rulers here? (For instance, accountability is something very different for Tesla than it is for NOAA.)

He emphasized that it's important to ask what we mean by innovation and how to operationalize it. What does innovation mean within the context of NOAA? What are the kinds of things that, because NOAA is a federal agency, impede potentially what we mean by innovation? That is, what are the kinds of structural, organizational and legal boundaries that we need to observe that don't allow us to do something we now call innovation?

He said it looks to him to be more like a structural analysis, which has been done many times in the federal government. He added that this is not the first time that an agency has said, "How can we be more innovative?"

Dr. Eric Kihn, NESDIS, said that there is a question of whether we are talking about being innovative or agile. He said he thinks we are really talking about making NOAA more agile. He mentioned the prototype example of bringing the cloud in, noting that Dr. Jacobs has put a lot of energy into this. He said that, for everyone he knows in industry, the cloud is now a commodity resource. The ship has sailed, and right now we're looking at harvesting from the community AI techniques, big science, and big data techniques.

**Social Sciences:** He raised the topic of the social sciences and said that when he hears coastal sciences discussed, NOAA has a hard time defining *what is a coastal science*, because there's ocean science, there's geophysical science, etc. He said that what really makes it coastal is somehow combining that with the social sciences. He thinks communities know how to do this. They know how to bring the impacts in, and posed: *Can the Science Advisory Board help NOAA become more agile and harvest what's readily available on the table in some really important areas that will let us do our mission really across the board?*

**Partnerships and Innovation:** The discussion turned to the topic of partnerships as raised by Dr. Joseph. He said he thinks one of the things important for the Advisory Board to do, and then also the committees and the working groups is. for any of these studies, a gap analysis of partnerships.

- How do we work with other agencies?
- How does NOAA work with other agencies and partners in terms of achieving the objectives?

He said (from his perspective at NCAR, DOE, and everybody else) that there appears to be a sort of myopia. He noted that partnerships are happening, but it's "do it here or all of us have five-year strategic plans," so we're all looking within the context of the five-year strategic plan and the goals and objectives, which breeds myopia.

Dr. Joseph said scientists are doing this work with very limited resources and piecemeal; therefore, he's not sure if government agencies, and centers like NCAR, are being focused

and looking at how to partner in a bigger way.

Dr. Tolman said the discussion was mostly about science and about fundamental science and changes. He said if we want to do a much more rapid transition to operations in general, we should not forget that we have private-public partnerships. A lot of the slowness of the National Weather Service in going into operations is not because of the aversion of risk at the Weather Service, but the aversion of risk with our downstream partners. Therefore, if we want to have this discussion about doing this faster, and being more agile, you have to actually start on the end-user side. He added that from his work, he has experienced doing more with less and quicker, rather than slower, because the environment he's worked in EMC (Environmental Modeling Center) is driven by end users.

Ms. Michelle Mainelli commented on NOAA's external partners and also the funnel of research to operations. She said, from the dissemination side, the issue is how NWS actually delivers all this information. She said we'll want this research to transition into something useful in the community, and that for economic purposes, from private industry all the way to the American public, we are going to see benefits.

#### **Other General Work Plan Topics:**

- **NOS Focus:** Chair Scarlett turned the discussion back to considering the topics covered in the 2018-2019 work plan that didn't link to the needs of NOS (as Dr. Werner had mentioned in the beginning of the discussion.) She suggested that the SAB think of how to deliberately incorporate NOS needs. She said this is where social sciences inclusion would be applicable. She said the whole area of Topic 5, having to do with social sciences, should be applicable and perhaps should be more visible in the next work plan.
- **Working Groups:** A second point raised pertained to working groups and how to be more responsive to interacting with working groups and asking them what they are doing – and thinking about how to build their plans into SAB work plans. She suggested having an element in the work plan that addresses each of the NOAA line offices and their priorities.

Dr. Werner said the three topics presented by the ESMWG are all valid. If they can all be pursued, that would be great. He raised a point on the deep uncertainty ESMWG topic related to predictability and the importance of making predictions. He referred to how Dr. Russell had been looking at envelopes of what might happen in the different Representative Concentration Pathways (RCPs) and so on. He said that for NMFS, something that changed things has been in the marine environment -- these marine heat waves that now are appearing everywhere. He gave the example of the marine heat wave that occurred in the North Pacific. The warming that happened there caught scientific experts and agencies, off guard, including all the climate models and whether it's S2S to S2D scales. No one had seen it coming.

Dr. Werner said he is not sure if there are many models, even retrospectively or in

reanalysis, or how they're being used now. But the heat wave had happened so quickly and so suddenly and yet it completely changed the way fisheries management happened, how the fishermen and the fishing community actually began to engage in questions having to do with what's happening with the ecosystem. He said the question to Dr. Russell is an example of deep uncertainty and the types of questions that the CWG is considering.

Continuing with that example, Dr. Werner said the fact that the North Pacific marine heat wave caught scientists off guard actually was very helpful. He said the reaction -- that scientists were baffled about the occurrence and unsure about how to make decisions -- actually brought them together, and there was benefit to that collective thinking.

He concluded his remarks by referencing Dr. Reed's comments, including with respect to emerging technologies in the social sciences and how this would be used in perhaps a more quantitative way. He said this was also one of the comments that had come from the social science committee of the Research Council.

- **Adaptation:** Dr. Reed emphasized again the importance of coastal adaptation as the most important crisis of our day and asked how the SAB could support NOAA on this topic. Chair Scarlett said that the topic is under-represented but important given the issues the nation will be grappling with: inundation and further impacts from storms and that type of thing along the coasts. She said there are some likely very important topics that are in NOS's interest that probably ought to be considered by the Science Advisory Board.
- **IEAs:** Dr. Werner returned to the topic of IEAs since there had been different viewpoints on them. He said that, over 11 years, IEAs have evolved and become part of the science that goes into Ecosystem Based Management or Ecosystem Based Fisheries Management. He said this is going into what we are developing now as management strategy evaluations. He said that coming back to the discussion of the socioeconomic dimension, the management strategy evaluations begin with the objectives of the different social sectors, whether they're fisheries sectors or energy sectors or quality of life sectors and so on. Dr. Werner said that IEAs provide the foundation that ultimately ends in a question: *What are the social requirements for management of the ecosystem or management of the environment?* He said the fact that IEAs have evolved did take time, and the IEAs were a bit amorphous to start with, but they have actually evolved to become a useful tool.
- **Social Sciences:** Chair Scarlett again raised the topic of the social sciences. She said the SAB is talking about the social sciences in two different ways, one more predominant than the other. In a lot of the discussions, the SAB has focused on a question of what elements are relevant to societal attitudes toward aquaculture, or to adaptation along coasts, and interventions. She said there is a second consideration that's often increasingly examined as one thinks about the social dimensions of decision-making. She raised these questions for the SAB to consider:

- What is the relevance of the decision processes and the decision structures themselves in terms of engagement of social sectors?
- And what is the relevance of co-development at the front end of any research on defining the problem set?
- Finally, what is the relevance of processes that allow for mutual learning as opposed to one-way transmission, 'here's our science; we're delivering it.'

The Chair said these are the kinds of questions that we're talking about and she is interested in the latter (co-development) as much as the former (social attitudes) because they bear on the relevance and meaningfulness of the research undertaken, the likelihood of uptake and use, the perceived credibility, and other things. She pointed out that these are two different clusters of research and consideration of social sciences.

### **Process for the Next Work Plan**

Chair Scarlett spoke a bit about the process for synthesizing the work plan brainstorming and coming up with high-priority topics. The July SAB meeting was a basis for getting the Board more focused and starting to brainstorm on the next plan.

A question was raised about new SAB members, expertise to move forward on the next work plan, and the expertise that will be brought to the table. New members, working group expertise and expertise of existing SAB members will help determine some matchmaking for topics to pursue. Dr. Decker noted the new ESMWG members coming on board, new EISWG and DAARWG members coming along and the request that will move forward this fall for new SAB members. Of the working groups, DAARWG has the fewest members at this time.

Chair Scarlett encouraged the Board to come up with priorities based on the synthesis of the July SAB work plan discussion. Eventually a document will be drafted, vetted by NOAA, then returned to the SAB and revised based on the agency's input. The Chair said the discussion had captured a lot of what is important about that topic and a future panel discussion at the SAB (bringing in experts) could help the Board with a deeper discussion. She said she would use the meeting summary prepared by NOAA to synthesize and cluster the topics for further discussion.